MATERIAL READINGS IN EARLY MODERN CULTURE

A Material History of Medieval and Early Modern Ciphers

Cryptography and the History of Literacy

Edited by
Katherine Ellison and Susan Kim

ROUTLEDGE

A Material History of Medieval and Early Modern Ciphers

The first material history of early modern cryptography, this collection brings together scholars in history, literature, music, the arts, mathematics, and computer science who study ciphering and deciphering from new materialist, media studies, cognitive studies, disability studies, and other theoretical perspectives. Essays analyze the material forms of ciphering as windows into the cultures of orality, manuscript, print, and publishing, revealing that early modern ciphering, and the complex history that preceded it in the medieval period, not only influenced political and military history but also played a central role in the emergence of the capitalist media state in the West, in religious reformation, and in the scientific revolution. Ciphered communication, whether in etched stone and bone, in musical *notae*, runic symbols, polyalphabetic substitution, algebraic equations, graphic typographies, or literary metaphors, took place in contested social spaces and offered a means of expression during times of political, economic, and personal upheaval. Ciphering shaped the early history of linguistics as a discipline, and it bridged theological and scientific rhetoric before and during the Reformation. Ciphering was an occult art, a mathematic language, and an aesthetic that influenced music, sculpture, painting, drama, poetry, and the early novel. This collection addresses gaps in cryptographic history, but more significantly, through cultural analyses of the rhetorical situations of ciphering and actual solved and unsolved medieval and early modern ciphers, it traces the influences of cryptographic writing and reading on literacy broadly defined as well as on the cultures that generate, resist, and require that literacy. This volume offers a significant contribution to the history of the book, highlighting the broader cultural significance of textual materialities.

Katherine Ellison is a Professor in the Department of English at Illinois State University, USA.

Susan Kim is a Professor in the Department of English at Illinois State University, USA.

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Contents

Figures and Tables

Figures

Tables

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Introduction

Ciphers and the Material History of Literacy

Katherine Ellison and Susan Kim

In 1916, Riverbank Laboratories and Director George Fabyan solicited the publication of primers to teach cryptography to the youngest audiences, aligning the pedagogy of reading with early training in deciphering. Dorothy Crain was "Director of Kindergarten" for Riverbank in Geneva, Illinois, a precursor to the National Security Agency located just west of Chicago, where she sponsored an instructional series that included Helen Louise Ricketts's *Ciphers for the Little Folks: A Method of Teaching the Greatest Work of Sir Francis Bacon*. Its title page summarized that it would "Stimulate Interest in Reading, Writing and Number Work, by Cultivating the Use of an Observant Eye."[1] The key philosophy behind using ciphers to teach reading, writing, and math is clearly outlined in the introduction:

> Children should have a great deal of handwork; they do their best thinking when they are planning something to do with their hands. Their attention is much more easily focused upon something they are doing with their hands than upon something which they hear or read. Building with the blocks, paper folding and cutting, painting and drawing, and what is known as constructive work, are all means of self-expression.[2]

Ricketts emphasizes the multimodality and the tactile, kinetic as well as visual and aural requirements of deciphering. Brainwork—the mental effort needed to perform academic tasks and solve problems—is supported by and not antithetical to handwork and the manual manipulation of objects. She stresses the materiality of the discipline, including the transformation of paper through cutting and folding, and that it is this materiality that makes it pedagogically successful.

After a quick explanation of Bacon's bilateral method and provision of a key to use throughout the textbook, sixteen lessons follow that require children to use their bodies in three-dimensional spaces to trace strings through sewing boards, to bead necklaces in which the patterns deliver a message, and even to notice illustrations of the nursery rhymes of their childhood—the Humpty Dumpty verse, for example—as layered with

meanings they can only understand once they have "trained the eye to see." (The wall that Humpty Dumpty sits upon is built by bricks that hide the plaintext "sat on a wall."[3]) Children are taught, too, that reading from left to right and from top to bottom of the page are Western habits that they must control and be able to break free from when the cipher requires other methods, such as reading in a circle, nonlinearly, or through images or sounds rather than alphabets. Finally, readers are also taught typography. The use of italic, roman, serif, sans serif, and other varieties of typographical styles, they learn, can communicate multiple messages. Above all else, children are taught the "adaptability" of their literacy:

> The adaptability of the Bilateral cipher to the manifold uses to which it can be put makes its pedagogical possibilities far-reaching; and the field for the exercise of the faculties of both teacher and pupil, parent and child, is one of the broadest, most instructive and entertaining that has ever been opened to the little folks of primary age.[4]

Ricketts emphasizes that ciphering is an entertaining way to interest children in literacy, an appeal to amusement and intrigue that medieval and early modern textbooks would also use to draw readers to their pages. The true goal of textbooks like *Ciphers for the Little Folks*, though, was clearly to create a generation of literate citizens so fluent in the languages and practices of cryptography that they would see and solve ciphers as second nature. They would be a generation always on their toes, aware that even a Mother Goose book of verse might hold secrets. Even if students were not as entertained by the lessons as Ricketts hopes, they would at least begin their personal literacy histories with the assumption that everything is potentially ciphered. Ricketts's pedagogy may not seem to have heavily influenced the K–12 public teaching of literacy in the U.S. during the twentieth century; however, many of the exercises themselves—cutting and folding paper as an assumed first activity, using sewing boards to build dexterity and simulate writing—were adopted as household educational practices, though their rhetorical purposes were divorced from the goal of teaching students to become not just expert cryptanalysts but intuitive ones, for whom seeing secret messages was second nature.

Literacy reform efforts like the one Ricketts, Crain, and Fabyan initiated were clearly built upon early modern innovations in reading, composition, and interpretation. They looked to the beginnings of the bureaucratization of intelligence, and to the innovations that preceded and followed the tumultuous Wars of the Three Kingdoms, to meet the challenges of twentieth-century global communication. Ricketts's model was Francis Bacon, but other cryptographers working before and

during Bacon's life were also inspiring models for not only the military work of World War I and the computing age that would soon follow, but also for twentieth-century textual theories. Considering the essays of this volume together, it becomes clear that the acts of ciphering and deciphering of the medieval and early modern periods have had a profound influence on the development of human literacy, on what it meant in the past, and what it means today, to be literate, to be adept with language, and to communicate with one another. The world that the kindergartener experienced during World War I was suffering from a crisis of trust. It was a world in which secrets had to be protected, in which even allies and friends could not necessarily be confidantes. The children of Crain's kindergarten were taught a literacy of self-protection and trained to believe that reading is always already the act of hiding and revealing secrets.

In his 1949 biography of Francis Bacon, Alfred Dodd declared the early modern period to be "a cypher age."[5] Yet, he notes, studying ciphers has been met with skepticism. There are many literary critics who "dislike cyphers," he explains, but often a critic dislikes ciphers "because he does not understand them." These critics "reject their usefulness in literary exegesis," but Dodd argues that "we cannot reject a story simply because it is written in code and not flaunted openly to the eyes of the world." Dodd calls this "code-complex-prejudice" and notes that "it is *the testing of the truth of the story* which matters."[6] What he means by "testing of the truth of the story" as a critical method is not described, but it is clear that he is referencing the theory that Bacon had authored William Shakespeare's writings. Dodd subscribed to Elizabeth Wells Gallup and Orville Ward Owen's debunked theory—funded by Fabyan just as the Riverbank kindergarten was – that Shakespeare was actually Bacon and that Bacon was the secret son of Queen Elizabeth I, as revealed, Gallup argued, through a ciphered history buried deep in Shakespeare's writings. The Oxfordian theory of Shakespeare's authorship is not our subject, though we do summarize some of the implications of its scholarship in our afterword. The literary scholarship of the 1940s and 1950s and the "Cypher-Story" of Bacon's identity, however, plays a role in this collection of essays. That scholarship drew attention to medieval and early modern ciphering, centralizing it in the history of literature and seeing in it a key for the reading and interpretation of all complex texts.

Material and Textual Timelines of Ciphering

The Voynich manuscript, most likely written in the early fifteenth century, is among the most famous of pre-1800 ciphers and was also one of the obsessions of Fabyan's Riverbank research. Just as important to

the history of cryptography, and to our understanding of medieval and early modern literacy, however, are the ciphers described in this collection that are less studied, either because they are elided in the context of interpretations of other kinds of texts, or because they are not recognized as successful ciphers, or perhaps even as ciphers at all. Ciphers occur in a variety of contexts in the early medieval period: on monuments, on moveable and portable artifacts, in manuscripts (as both text proper and as marginalia), on maps, and in personal and official communications. We note as well that ciphers were explicitly understood as materially instantiated in the body of the cipherer himself during this period. In Chapter 3, Stephen J. Harris, for example, discusses the eighth-century Venerable Bede, who in his *The Reckoning of Time* explains the extension of finger-counting to ciphering in the first section of the treatise, on "Calculating or Speaking with the Fingers": after explaining how to count up to a million on one's fingers, palms, neck, chest, belly, thigh, and groin, Bede explains how to cipher by substituting letters from the Latin or Greek alphabets for numbers represented on the body, in case "you wish to warn a friend who is among traitors to act cautiously."[7] For Bede, transfer from this physical ciphering to writing increases secrecy, not surprisingly given the association of writing itself in this period of transitional literacy with both a contradictory impermanence (given the inevitable degradation of physical materials compared to the durability of memory and yet the capacity of writing to evoke memory) and secrecy (given limited literacy).

In fact, the very newness of the techne of writing during this period reduces the distance between ciphering and non-ciphered textuality as it occurs in later periods. For example, the left to right progression and the division of texts into words separated by spaces or other marks, habits of reading even in the High Middle Ages, are much less deeply ingrained in the early period. It is common for unciphered runic inscriptions to be written in boustrephedon, for example (right-to-left and left-to-right in alternation), or backward (as on the eighth-century Franks Casket).[8] Unciphered runic inscriptions can even occur in a cross and/or in circular cluster: Michael Barnes lists "two sixth-century southern German manifestations (on a sword from Schretzheim and a fibula from Soest), and a late Viking-Age example from Ludgo, Södermanland, Sweden" of this type as well as, from Tønsberg, Vestfold, in Norway, "a bone inscription dated to the thirteenth century in which the branches of the runes are attached to a cross within a circle." As Barnes succinctly concludes, the difficulty in interpreting these inscriptions is "not in identifying the runes, but understanding what they say."[9] And even within a left-to-right pattern, many early medieval manuscripts are written as often were classical texts, in *scriptio continua*, with no breaks at all between words, from margin to margin, and with no punctuation.[10] As Katherine O'Brien O'Keeffe has argued, writing "introduces a new

element of meaning into previously aural language: significant space." In this "significant space" as it develops in the early Middle Ages, she argues,

> [d]ots and marks indicate special status for portions of text; scripts and capitals indicate a hierarchy of material and meaning. Literacy thus becomes a process of spatializing the one-exclusively temporal, and the thought-shaping technology of writing is an index of the development of this process.[11]

The degree to which our present perspective is profoundly literate, then, or our profoundly "literate ideology," as O'Brien O'Keeffe suggests, naturalizes that spatialization as its "most powerful characteristic is to blind us to the visual dominance of our own thought processes."[12] As Fletcher Pratt puts it (in 1942),

> today all written language is cipher.... We are apt to lose sight of this today because most people learn to read early in life; but it is only necessary to remember the Middle Ages, when a man who could read was about as rare as a telegrapher is now.[13]

In the early Middle Ages, before our "literate ideology" is so fully formed, ciphers provide a challenge less in their alterity to textuality than in their exaggeration of it.

Although they are not technically ciphers, the complex word-image creations of the ninth-century Rabanus Maurus emphasize the sometimes dizzying sense of the conscious enmeshing of letters and visual images in this early period. Perhaps most clearly, in terms of actual ciphering, many of the runic cipher systems preserved from the Germanic world present the cipher *as* visual image. The hahalrunes are a very basic form of these ciphers, in which "twigs" attach to either side of a vertical to create ciphers with tree-like shapes, as found on the eighth or ninth century English Hackness stone. These ciphers are elaborated, for example, on a rune stick from Bergen, Norway, which features not only twigs on either side of a vertical but also hairs on either side of beards on tiny faces and fish figures with spines or fins on either side of their bodies. Even more elaborate are the rune ciphers drawn in the later "Icelandic Runic Poem manuscript," AM 687d4°, Stofnun Árna Magnússonar, Reykjavík (c. 1500), which include figures of ships, pigs, knives, and shields.[14] These ciphers are visual images: we see them as men, fish, trees, or pigs. But they are also intended to be *read*, as ciphers, and as text; that is, to read them as ciphers we must approach them not with the simultaneity of apprehension of the visual image, but through the sequential unfolding of (alphabetic) text.

These runic ciphers exaggerate the contradictory visuality of writing, in which the letter is also an image but cannot be apprehended as such if

it is to be read as a letter. They also, like many of the other ciphers of the Middle Ages, exaggerate the function of what early medieval theorists considered to be an essential property of the letter itself: sequence. The great sixth-century encyclopedist Isidore of Seville, for example, in the first book of *Etymologies* ("De Grammatica"), writes of the letter,

> There are three things associated with each letter: its name, how it is called; its shape, by which character it is designated; and its function, whether it is taken as vocalic or consonantal. Some people add 'order,' that is, what does it precede and what does it follow, as A is first and B following—for A is the first letter among all peoples, because it first initiates voice in babies as they are being born.
>
> (I.iv.16)[15]

The runic ciphers we have been discussing of course function on the premise of a predictable sequence of runes. The twigs on one side of the vertical represent which section of the futhark is being indicated, and the twigs on the other side of the vertical indicate how far into the sequence of that section the plaintext rune would fall. In the absence of a predictable sequence for the futhark, the cipher could not work. The many other kinds of substitution ciphers that circulated in the medieval period similarly rely on a stable alphabetic sequence: the dot ciphers or vowel substitutions, for example that Isidore refers to in his subsequent section on epistolary codes, literally "on codes of letters" ("De notis litterarum"), in which "we will replace each letter with the following letter in this way: *b* for *a*, *c* for *b* and then the rest in the same way" (I.xxv), and that, as they occur in collections like the tenth-century Exeter Book, are discussed by Harris, E.J. Christie, and Asa Mittman and Susan Kim in this collection.[16] The cipher in this instance simply extends a property of the letter as it is already understood.

Given that sequence is a property of the letter, and that sequence is manipulated in the creation of the substitution cipher, it is not surprising that substitution ciphers occur not only in literary texts and treatments of grammar but also in the context of mathematical and scientific writing in the medieval period as well. As Harris notes in his chapter in this volume, in the tenth-century Karlsruhe, Badische Landesbibliothek, Codex Augiensis 205 manuscript of the collection of mathematical word problems attributed to the eighth-century Alcuin of York (Northumbrian scholar, advisor to Charlemagne, and abbot of Tours), a pursuit problem in which a hound pursues a hare features a title in a combination of a vocalic and dot substitution cipher. While the narrative of the word problem involves a literal collapse of sequence, in which the hound, after a delay, finally catches up to and seizes the hare, the mathematical exercise requires the calculation of delay before that collapse: the number of leaps the hound must make, given the hare's headstart, before the

hound seizes the hare. Deciphering the title of the proposition, aligning the letter with the "headstart" and the letter that precedes it in the Latin alphabet, thus replicates both the narrative and the mathematical processes, and all end with comprehension (a play, in the Latin, on the word "comprehensus," or "seized"). And the manuscript Augiensis 205 also contains several literary riddles similarly enciphered under the heading "Enigmata rkskbkkb," "Enigmata risibilia," or "Amusing Riddles."[17] Perhaps the most famous and yet not-much-studied of later enciphered texts from the English Middle Ages is similarly associated with both literary and scientific texts: David Kahn cites the substitution cipher at the conclusion of *The Equitorie of the Planetis*, found in the fourteenth century Cambridge, Peterhouse 75.I manuscript. *The Equitorie of the Planetis* occurs with other texts in the same hand, among them a set of tables with the note "Radix Chaucer," and for that reason has been associated, however problematically, with Geoffrey Chaucer, and in particular with Chaucer's "Treatise on the Astrolabe."[18]

The scientific context of these ciphers also grounds their early appearance in scenes of explicit pedagogy. Chaucer frames the "Treatise on the Astrolabe" as a response to the interest of his young son, in whom he can perceive, "by certeyne evydences" an ability to "lerne sciences touching nombres and proporciouns."[19] The description of the finger cipher in Bede's *The Reckoning of Time* is part of a preliminary training exercise in

> that very useful and easy skill of flexing the fingers, so that when we have conveyed maximum facility in calculation, we may then, with our readers' understanding better prepared, attain equal facility in investigating and explaining the sequence of time through calculation.[20]

The enciphered mathematical word problem attributed to Alcuin, as a clearer example, occurs in a collection entitled "Propositiones ad acuendos Iuvenes," "Problems for Sharpening the Young." "Acuo, acuere" means literally "to sharpen, to whet" as in sharpening a sword, a spear, or teeth, and this literal sharpness is actualized within the narratives—for example, in the "gripping teeth" of the hound as he catches the hare. But figuratively of course "acuo, acuere" means "to sharpen or exercise" the mind or the tongue, and in this sense the pedagogical scenes for these texts offer their ciphers as a means not unlike Ricketts's exercise to "Stimulate Interest in Reading, Writing and Number Work, by Cultivating the Use of an Observant Eye."

These texts focus on the fundamentals of medieval education: categories of difference and reckoning, or the understanding of difference, which Isidore identifies as the basis for everything: "Remove numbers from all things and everything perishes.... Those who are ignorant of the method of calculation cannot be differentiated from the other

animals."[21] The musical notation ciphers of Visigothic Spain, examined by John Haines and Elsa DeLuca in this volume, might find congruence with this category, both because music was understood as part of mathematics, and because at the same time musical notation itself participated in visual literacy. But that these texts focus on or re-present the fundamentals of education through the manipulation of the letter in the ciphers they include also underscores the function of the letter itself in medieval pedagogy, literary theory, and literate practices. The letter, as Martin Irvine has demonstrated, is represented as the foundation of literacy in early medieval grammatical treatises. Irvine cites, for example, the anonymous "Interrogatio de litteris": "Fundamentum sapientiae littera est" ("The letter is the foundation of wisdom").[22] As the indivisible even atomic element of sound represented in writing, the letter is also "in a metonymic sense, writing itself," and as such both the material of textuality and the cultural matrices it both reflects and produces.[23] Irvine explains,

> Thus when a student entered the ranks of the *literati* through the grammatical curriculum, he or she was learning far more than the obvious subject matter of the discipline: a student was being inducted into a whole social system, internalizing the structures of authority that were reproduced and guaranteed by *grammatica*.[24]

The association of the letter as the foundation of such a system, then, makes the appearance of enciphered signatures like those of Coleman (d. 1113), or even the Cynewulf signatures, all the more powerful.[25] Like other early ciphers, these may be read simply as literary in-games. But at the same time they make the powerful point that in the capacity to manipulate the letter, as demonstrated by the cipher, the literate subject—both the cipherer and the reader—lays claim not simply to a skill or a facility, but to an identifiable subjectivity constituted through those particular literary practices. Irvine makes the provocative claim that "[a]ll of Western society is thus post-medieval in a significant sense: the grammatical archive continues to shape the understanding of texts, the literary canon, and literacy."[26] That particular literacy continues to produce, to reproduce, and to authorize its subjects, even when the social and political worlds in which that literacy is imbricated appear to have changed dramatically.

De Luca and Haines point out, in Chapter 1, that approximately ninety-three medieval sources exist that are known to contain cryptographic neumes, but that an even larger number has most likely been lost because the ciphers were written on unsustainable surfaces like wax. More ciphers are available for scholarly analysis from the tumultuous years of the Wars of the Three Kingdoms, when records of ciphered correspondence provide the main textual evidence of the discipline's

development, yet an unknown number from this period, too, are not retrievable or legible. Queen Elizabeth, Mary, Queen of Scots, Nicholas Wotton, ambassador in France under Henry VIII, Mary I, Elizabeth I, Sir William Pickering, Francis Walsingham, William Cecil, Nicholas Throckmorton, Sir Thomas Smith, Thomas Chaloner, John Somers, Sir Henry Cobham, Henry Norris, and Thomas Randolph, just to name a few available records, all authored numerous ciphered letters accessible in the archives. Sir Edward Nicholas's voluminous preserved correspondence also provides a persuasive example of cryptography in practice.[27]

Lois Potter's *Secret Rites and Secret Writing: Royalist Literature 1641–1660* (1989), a foundational study for any scholar working in the history of early modern cryptography, affirms that ciphering was common enough by the seventeenth century that it even changed "part of the consciousness of the period" and "had more than a metaphorical meaning."[28] Ciphering *was* integral to practical literacy, and it even began to become commercially successful as well. Potter proposes, too, that ciphers were promoted, rhetorically, as the answer for purer, clearer, faster human communication, a language flexible enough to be adapted under sudden as well as gradual change, perfect for the fluid boundaries and exchanges increasingly common in the global economy. Potter acknowledges that this ambition is evident in the instructional manuals of the period, but the everyday uses often fell short. Karen Britland, who has contributed to this collection, Sarah Poynting, and Nadine Akkerman have all discussed ciphers in use during the period, and they find, as Potter does, that practitioners did not typically experiment with the more elaborate methodologies imagined in instructional manuals, which form the main textual history of the discipline.[29] The diplomatic correspondence of Thomas Bodley proves to be one exception; the founder of the Bodleian Library did use a more elaborate table of symbols, often in Arabic, than other cipherers did.[30] We know, too, that scientists and Royal Society members occasionally used ciphers in their communication of technical knowledge. In 1644, Michael Van Langren ciphered the solution to the exact location of longitude in *La verdadera Longitud por mar y tierra*. Giovanni Fontana ciphered descriptions of machines in *Bellicorum Instrumentorum Liber* and *Secretum de Thesauro*. Robert Boyle used ciphers to disguise his chemical discoveries that were easy enough for learned colleagues to decrypt but too puzzling for his assistants.[31] Across Europe, more ciphers are found each year. Benedek Láng, for example, has discovered a wealth of materials in collections of Habsburg diplomacy. In Chapter 11, he describes the early modern Hungarian tradition, surveying keys located in diplomatic correspondence, family records, and documents about anti-Habsburg uprisings.

The textual history of ciphering as described in treatises, instructional manuals, modern textbooks, and even literary and artistic representations, for which we have more leads in library catalogs, reveals that

ciphering and deciphering were acknowledged as politically and socially significant activities long before the bureaucratization of intelligence under Queen Elizabeth, or, more officially, King Charles II. Participating in medieval and early modern conversations about the occult and the rise of the new sciences, methods were shared even before they were formally recognized as a scholastic discipline by Royal Society members like Francis Bacon, John Wilkins, and John Wallis. Ciphering and deciphering survived extraordinary communicational, theological, and political changes across many centuries, and they were often described as the answers to global communication breakdown, as Potter has noted, when commerce and knowledge exchange between cultures, geographies, and languages became economic and philosophical necessities for European and English communities, in particular.

The textual tradition of writing about and explaining ciphers is believed to begin in Italy with Cicco Simonetta's 1474 two-page tract featuring thirteen guidelines for substitution ciphers, published in Milan.[32] While our volume does not complicate those origins, we note the many fragmentary descriptions of ciphers and cipher systems in early sources like Isidore, Bede, and Rabanus, given fuller treatment by Harris and Christie in this collection. Later writers like Wilkins, author of the first English manual entirely dedicated to cryptography instruction, *Mercury; or, the Secret and Swift Messenger* (1641), will also cite much earlier writers who provided descriptive accounts of ciphers in practice, including Polybius, Virgil, Cleomenes, Democritus, Julius Africanus, Philo Mechanicus, Marcus Valerius Probus, and other Greek and Roman authors who establish, for him in 1641, a solid precedent upon which to build his argument that cryptography is a legitimate scholarly discipline with real-world application that has stood the test of time.[33] While the gap between Wilkins and the classical authors he cites is notable from the vantage point of the present awareness of ongoing ciphering in the medieval world, between the Romans and Trithemius, little had been written that was available in the early modern context. Only in relatively contemporary scholarship has the richness of ciphering in Viking, Runic, and Irish contexts before Trithemius been documented.[34] Hildegard von Bingen's cipher alphabet in the eleventh century, for example, was apparently unknown to seventeenth-century cryptographers. Wilkins understandably misses a number of important sources, such as Giovanni Soro's *Liber zifrarum* (1539), and he does not mention that Italy's tradition was so deep that the position of Cipher Secretary had been established by 1555 under the Argenti family.[35] This narrative of Italian origin also overlooks the rich early Middle Eastern and Asian traditions, currently chronicled by the King Faisal Center for Research and Islamic Studies, which has committed to nine volumes for a series on Arabic Origins of Cryptology. At least five are complete, including an explication of al-Kindi's detailed ninth-century treatise.[36]

In most studies, the English tradition begins with Roger Bacon's thirteenth-century *Epistle on the Secret Works of Art and of Nature and on the Nullity of Magic*. The *Epistle* contains seven secret communication methods such as words that omit vowels, hybrid languages (in which words might alternate between Latin and Greek, for example), shorthand and artificial languages, invented languages and alphabets, figurative language, geometric characters, and magic spells. Bacon's *Epistle* was revived upon its translation into English in 1659 as *Frier Bacon His Discovery of the Miracles of Art, Nature, and Magick*, after which its influence on seventeenth-century thought and the culture of ciphering was evident.[37] Also popular was the legacy of the German cryptographer Trithemius (pseudonym for Johann Heidenberg), who like Roger Bacon occupied a controversial status as an occultist. Trithemius's teachings influenced English cryptography during the Wars of the Three Kingdoms, and as Katherine Ellison establishes in *A Cultural History of Early Modern English Cryptography Manuals* (2016), seventeenth-century cryptographers rhetorically dismantled Trithemius's occult ties to legitimize cryptography as a new science yet also, strategically, capitalized upon the public interest that the occult sciences could generate.[38] Though there is no essay dedicated explicitly to Trithemius in the current volume, his presence is felt in the histories described here. The legacies of *Steganographia*, which combined cryptographic training and occult instruction, and *Polygraphiae libri sex, Ioannis Trithemii abbatis Peapolitani, quondam Spanheimensis, ad Maximilianum Caesarem*, published in 1518 after Trithemius's death in 1516, are noted in Quinn DuPont's Chapter 5 on the relationship between cryptography and early printing. Operating across oral, manuscript, and print cultures, Trithemius's handwritten manuscripts traveled so quickly across the globe that his occult ties seemed certain, and the contemporary reach of his posthumous writing testified to the technological advancements of the printing press. When Jim Reeds, a mathematician writing from the AT&T research labs in 1998, solved the alleged hoax cipher in Book III of *Steganographia*, in the process revealing that Gustavus Selenus had also understood it in 1624, the cryptography community had to revise its history and acknowledge that past demonstrations dismissed so quickly might actually have merit.[39]

Figures like Trithemius, well known by scholars of cryptography, are only part of the historical timeline sketched by essays in this volume. Láng remarks, in his essay on the understudied but rich archive of early modern Hungarian ciphers, that while Trithemius's methods were sophisticated, they do not accurately represent ciphering taking place during the sixteenth century.[40] Láng analyzes the homophonic cipher, popular in practice but little discussed in the textual history of the field. Certainly, central Europe's experience of the devastating Thirty Years' War of 1618–1648 also necessitated that region's familiarity with secret

communication methods. After Trithemius, interest in cryptography steadily increased, with the seventeenth century seeing a large number of published manuals teaching the discipline. Writings by Giovanni Battista Palatino, Girolamo Cardano (or, Jérôme Cardan), Giovan Battista Bellaso (first to describe the Vigenère Cipher), and Leon Battista Alberti were well known during the seventeenth century but have still not been adequately researched. Giambattista della Porta (or, Giovanni Battista Della Porta) has been more frequently studied, but there is still much work to be done to better understand the cultural contexts of his and his colleagues' writings.[41] Della Porta's *De Furtivis Literarum Notis* (1563), for example, includes stunning three-dimensional illustrations and example ciphers that emphasize multimodality.[42] Thanks in part to Fabyan's ambition to resurrect him as the mastermind of the period and the secret author of Shakespeare's writings (and to nineteenth-century scholars like Delia Bacon, whom we discuss in our afterword), Francis Bacon is of course an exception: his role in innovating ciphers and promoting cryptography as a reputable discipline has been more rigorously studied, drawing literary scholars to a field they might otherwise ignore.[43] Bacon's contributions to cryptography history are noteworthy yet not as significant as the documents and methods authored by many of his predecessors and colleagues. His earliest textual discussion of cipher, in *The Twoo Bookes of Francis Bacon. Of the proficience and advancement of Learning, divine and humane* (1605), was brief, summarizing only that wheel ciphers, key ciphers, and doubles were the three main contemporary methods of deciphering and that the "highest Degree whereof, is to write OMNIA PER OMNIA; which is undoubtedly possible, with a proportion Quintuple at most, of the writing infoulding, to the writing infoulded, and no other restrainte whatsoever."[44] He would write more about this theory that anything that can signify anything in *De Dignitate & Augmentis Scientiarum* (1623).[45]

Following Bacon, Francis Godwin published *Nuncius Inanimatus* (1624), which was the inspiration for Wilkins's 1641 publication of *Mercury*. Wilkins does owe a debt to Bacon's discussion of bilateral cipher, but as Ellison describes in Chapter 9, Wilkins's advocacy for multimodal pattern recognition goes further than Bacon's briefer treatment. Bridges's *Stenographie and Cryptographie* appears in 1659 and its sequel, *Rarities*, in 1665, the year during which Gasparis Schotti published the visually stunning, highly multimodal *Schola Steganographica* (1665), also referenced in Ellison's chapter.[46] Morland's *New Method* was being circulated amongst Charles II's circle in 1666; it is a brief pamphlet that is rarely mentioned in cryptography histories, and it is notable for its geometric innovations and Morland's technological modifications of the cipher disk. Johannes Balthazar Friderici's *Cryptographia oder Geheime schrifft- münd- und wurckliche Correspondent* (*Cryptographia; or, Secret Writing*) (1684), too, is visually impressive: it is a German

translation of Trithemius and Selenus. John Falconer's *Cryptomenysis Patefacta* (1685) is also noteworthy because it advances columnar transposition and showcases material innovations, including the folding of letters to reveal alternate readings. None of these publications mentions the ongoing work of John Wallis, who had recorded several of his methods in papers in 1653 and deposited them at the Bodleian Library some time later, but who had refrained from publishing them. They were not shared until John Davys edited the Wallis archives in *An Essay on the Art of Decyphering* (1737).

Our collection ends, during the eighteenth century, where other histories often begin (for example, with the American Revolutionary War, the French Revolution, and industrialism), but in the afterword, we look to nineteenth-century and early twentieth-century excavations of the early modern archives to survey the implications of those periods' scholarship. As we note in the final chapter, nineteenth-century historians and literary critics including Delia Bacon, William H. Smith, Catharine F. Ashmead Windle, Ignatius Donnelly, and Charles W. Augustus brought attention to the importance of early modern ciphering, even proclaiming that:

> It was a time when puns, and charades, and enigmas, and anagrams and monograms, and ciphers, and puzzles, were not good for sport and child's play merely; when they had need to be close; when they had need to be solvable, at least, only to those who *should* solve them. It was a time when all the latent capacities of the English language were put in requisition, and it was flashing and crackling, through all its lengths and breadths, with puns and quips, and conceits, and jokes, and satires, and inlined with philosophic secrets that opened down "into the bottom of a tomb"—that opened into the Tower—that opened on the scaffold and the block.[47]

By "latent capacities," Delia Bacon points to the literary devices through which the English language communicated ambiguity and double and hidden meanings, and she suggests that the English language was on the cusp of finally coming into its own as a rich, flexible language. She suggests, too, that the early modern period experienced major ontological and semiological shifts, which it did, though those changes had been taking place over time and not only across the lives of figures like Francis Bacon. Linguistic isolationism was a concern of the medievalists and the early modernists, and the quandary of how to express human emotion more effectively, yet with more control over which audiences shared that expression, was central to conversations in science, theology, politics, and the arts. Christie's chapter emphasizes the function of ciphering in Old English poetry, for example, as response to what might be described as a crisis of intimacy.[48] The implications of this development in literacy,

in response to these significant dilemmas, and of the methodologies of those first scholars of early modern ciphering, were far-reaching, as our afterword illustrates through readings of the World War I archives and published scholarship of John Matthews Manly, William Newbold, and later New Critics and historicists such as Frank H. Ellis and William H. Epstein.

Ciphers and Literacy: Key Findings

Aware of the scholarly traditions (and damaged reputations) of those who have been debunked, like Delia Bacon, Smith, Donnelly, Augustus, and Newbold, and by those who have adjusted the history of criticism in response, such as Manly and Epstein, this collection seeks to extend the bridge that David Kahn, in 1967, also began to construct between the humanities and the cryptography community, adding to that community current scholars of the arts, mathematics, the sciences, and the social sciences whose work in the history of cryptography has been well received within their own disciplines but less familiar across scholarly boundaries. The compartmentalization of history and theory within academics and the structures of higher education have hindered cross-communication between fields that could be learning a great deal from one another. We argue that the broad early modern period deserves focused attention—not with the ambition of unearthing a revolutionary new truth or solving a riddle that will change the world—if we are to understand the significance of cryptography in the twenty-first century, and enough work has been done on artifacts created and interpreted before and during the early modern period to warrant anthologies that can now showcase the breadth and depth of historical analysis available. With respect, we take polite issue with Kahn's characterization of the seventeenth century. His observations that the authors of this time "borrowed their knowledge from earlier volumes and puffed it out with their own hypothesizing" and that "the literature of cryptology was all theory and no practice" have encouraged us to investigate both the material and the textual traditions of cryptography during the seventeenth century but also before it, to offer new perspectives on accepted timelines.[49]

The scholarship of cryptography often pauses to define the two main terms of its scrutiny, "code" and "cipher." Any solid collection should define its terms, and the terms of cryptography history deserve particular attention because they have changed over time. In the late fourteenth-century *The Testament of Love*, allegedly written by Thomas Usk but not printed until 1532 by William Thynne, a cipher, or "sipher," was any character without meaning or value on its own, yet "he yeveth power in signification to other."[50] Ciphers were often numeric, and at the least symbolic, and they granted "power" to the characters around them through a kind of multiplication. This identity

of the cipher as always cooperative and relational, as meaningless until its place within a grammar creates worth, is perhaps what makes it most intriguing to scholars of language and the arts.[51] Through the centuries we study, the kinds of relationships that ciphers require and thrive upon reveal exciting dialogues. How do images and words create meaning together? What meanings are possible when a single communication act crosses stone, flesh, wood, and paper? When a handwritten message is traced upon a printed page in invisible ink and mobilized through the portable technology of the book? When a hand can gesture, light a fire, and also run across a surface of raised dots and lines? Ciphers are syntactical and algorithmic—they have a grammar and require a series of instructional steps to solve, and they require a key through which the sender and receiver can understand what functions are performed at what steps. "To cipher" commonly now means "to calculate" and work arithmetically toward a single solution. But by the late seventeenth century, ciphering was used in architectural works, like William Petty's *The Discourse Made Before the Royal Society … Concerning the Use of Duplicate Proportion* (1674), as a chipping or carving away—as a process of crafting a difficult surface into something symbolically meaningful and aesthetic. Deciphering is the craft of reconstructing those steps either with or without access to the key. Codes, in contrast to ciphers, are semantic—one word or phrase that has meaning is mapped onto another that has meaning on its own, and a codebook is required that explains those mappings. Ciphers, unlike codes, require problem solving that can shift method, direction, and even surface across time and space. Computers can do this work to a point. Medieval and early modern ciphers, however, work at the boundaries of modalities in ways that even the most sophisticated digital decryption cannot. They require the interaction of the human. Certainly, some early modern ciphers could be solved with simple algorithms: King Charles I frequently used the same numbers as codes for his colleagues' names, for example, which is why the letters seized at Naseby were so easily translated. Yet even the idea of the "digital" is reconceived within the context of the medieval and early modern cipher, for cryptography of these periods demands the dexterity of the digits—of the fingers and the body—in ways that our current age has at times not lost but lost the consciousness of (the role of the fingers as swiped across a touch screen or in the automatic recall of key locations, for instance). And just as Usk's "sipher" lacks meaning on its own, decontextualized until it is part of a collaborative grammar, so too do the acts of ciphering and deciphering require contextualized analysis to find their value within the cultures of medieval and early modern communities.

Brian Stock frames the history of reading with a simple chronology: it "can be divided conveniently into five phases, dealing respectively with oral traditions, alphabetic literacy, rolls and manuscripts, printing, and

computers (including advanced telephones)."[52] Stock's research is useful for establishing a pattern for communication, but it is not comprehensive, and its organization of the history of literacy according to phases that can be chronologically and even hierarchically stacked against one another is problematic when one considers media that are more broadly multimodal. A study of ciphering reveals a rich corpus of human communication always self-reflexive and aware of the perceived boundaries between the oral and the written, the alphabetic and the numeric, the handwritten and the printed, the manual and the automated. Those who send secrets in cipher must understand the compositional and interpretive conventions of their own time and manipulate them to send truths so dangerous or scandalous that they must be hidden.

A cipher's reliance upon, yet manipulation of, compositional and interpretive rules is its defining feature, and the ways in which ciphers mirror their cultures' fantasies of literacy—and then shatter those mirrors to obscure their messages—provide a focus for cultural analysis. Stock finds that "sets of rules, that is, codes generated from written discourse, were employed not only to produce new behavioural patterns but to restructure existing ones."[53] Certainly, communicating in cipher requires strict adherence to a set of rules decided upon by sender and receiver; successful transmission of messages depends upon a contractual relationship in which the parameters and sequences of the exchange are pre-structured, and the behavior is determined by that agreement. Stock uses the terms "codes" and "encoding" casually, to indicate rule-based conventions developed in language use to standardize practice and interpretation. It is helpful, however, to look closely at Stock's impulse, here, and to consider the implications of the kind of literacy that he grants the practice of coding. First, he proposes that codes *produce*, and that they specifically not merely cause but create behaviors that are new and that can be recognized as patterns. Coding also modifies behaviors through a process, it is implied here, of disassemblage and reassemblage—a "restructuring" of patterns already established.

If it is true that written discourse caused cultures to behave according to new and modified patterns, what behaviors changed, and what did those patterns look like? What does this production and restructuring look like in practice? Stock notes that after the development of writing, "one no longer responds through inherited principles handed down by word of mouth. The model is now exteriorized."[54] "Individual experience still counts, but its role is delimited," he explains, "instead, loyalty and obedience are given to a more or less standardized set of rules which lie outside the sphere of influence of the person, the family, or the community."[55] These are interesting observations if read alongside the history of ciphering. On one hand, cipherers and decipherers must remain loyal and obedient to the rules they themselves create, and for long-term communication, standardization of those rules does speed encryption

and decryption. The model by which they compose and read is exteriorized, in a sense, and in some cases it is even projected onto a technological object like a cipher disk. On the other hand, the best cipher is one in which the model can be completely internalized, or interiorized, within the sender and receiver—instructions that must be written down weaken the cipher because they can be confiscated.

Decryption also requires an intimate knowledge of the *kairos* of the message; readers must know, through their experience and familiarity with the senders, whether a message that says "We are healthy" on the surface needs analysis to reveal the counter message, "Starving: Please Send Food." Individual experience, and the sphere of influence of person, family, and community, can be everything in a ciphered exchange. That experience, and those influences, are also always changing, especially in wartime. One must know, down to the minute, who is doing what, when, and where. Arguably, the purpose of ciphering is to gather information about these continually changing experiences and spheres of influence, to track how communities change in real time. The discipline requires this experiential adeptness and also, depending upon the cipher, advanced mathematical, computational, and linguistic expertise, and perhaps even knowledge of musical notation and a wide range of sign systems spoken, bodily, and written. The process by which all of this knowledge is put into motion should be very quick. The ingenious decipherer who has interiorized the rules might glance at a cipher and simply *know* what it says, see the solution clearly in an instant. In this image of the ingenious decipherer is the fairy tale of the beautiful mind or, as Wilde notes in Chapter 7, "the romance of symbolic revelation."[56] Ellison looks more closely at this portrait of the mind in Chapter 9.

The assumption that ciphering and deciphering are therefore entirely rule-based, logical processes that proceed step-by-step without emotion, spontaneity, experiential knowledge, or creative problem solving has perhaps been the most damning obstacle for the discipline of cryptography and a hindrance for scholars interested in its history, and it minimizes the flexibility that such communication must allow. For this reason, algorithmic literacy—the ability to build or follow a set of instructions, a series of steps, to solve a problem—is only one of the kinds of literacy at stake in the ciphers at work in the following chapters. Today, humanists are calling for literacy reform that pays attention to the importance that algorithms play in our daily lives, urging users of technology to better understand the hidden directions that guide internet browsers, for example. Early cryptography teaches us that this call for algorithmic literacy is not new, and it also reveals that literacy was never limited to or defined by textuality. It may also cause us to question the impact that we have granted to alphabetic writing, which is implied to be the type of writing referenced when scholars like Stock distinguish between the oral and the written. Ciphers, which predate alphabetic literacy, do not

need to be written down to communicate, as DeLuca and Haines report in Chapter 1 on musical notation. Still today, ciphering using gesture—gang signs, for example—thrives in communities that must engage in secret communication. Michael C. Clody discusses, in Chapter 8, the significance of gesture in communicating what alphabets cannot, pointing to the limits of alphabetic literacy to serve the needs of seventeenth-century communities. Ciphers do not need to be written in graphic fields we typically think of as writing surfaces. On public surfaces, graffiti has always been common, and one of the hallmarks of the cipher is that it can and should appear in unlikely places that fall outside of the periphery of typical human habits of observation, on planes that we are taught to ignore. Britland's discussion of invisible ink, in Chapter 10, emphasizes how letters are sometimes containers for other letters; messages may be inside other messages, "waiting to be activated" when the reader figures out what to *do* with the paper.[57] This problem-solving process requires that readers approach texts, in Tim Morris's words, as "objects of the world" first.[58] Kim and Mittman explain, in Chapter 2, how the sides of the Franks Casket talk to and against one another, involving the reader in three-dimensional interpretation that requires manual repositioning of the box in space. The Franks Casket challenges its culture's reading practices, specifically how it reads images and texts together.

In addition to presenting models of literacy that can account for the ever-changing multimodalities of human experience, cryptographers advocated for a kind of anti-literacy—a resistance to succumbing fully to the conventions and rules of a technology and to the new behavioral patterns it structures (or restructures). Ciphering anticipated inevitable technological breakdown and the adaptation necessary should users accustomed to only one way of doing things suddenly find themselves in situations (as cryptographers often did) in which traditional rules of behavior, or even the typical choice of tools, no longer applied. In a sense, those who provided instructions for ciphering and deciphering called for a more nimble, flexible community model of intelligence and knowledge sharing. While other histories only discuss the technical advances of early modern practices, this volume examines the ways in which those practices were culturally, socially, and technologically connected to other innovations, institutions, and practices at the time.[59] Chapters in this volume ask if we have adequately theorized the technologies through which reading and interpretation occurs. DeLuca and Haines find, in Chapter 1, that scribes used ciphers to intervene in their own automation as copiers. In Chapter 4, Christie reminds us of effraction, the moment when the sky opens and angels can view humankind, comparing the page to the firmament upon which the angels watch human behavior. In Chapter 5, DuPont investigates Leon Battista Alberti's cipher wheel *as* a writing technology, noting how Alberti saw in ciphering the potential for technologies, like the printing press as well, to move away from mimetic

representation and toward a "notational epoch."[60] Ellison points out, in Chapter 9, that the habits of alphabetic reading in print narrow the field of vision, and cryptography instruction of the seventeenth century reminded readers to be mindful of those limitations when attempting to make meaning from patterns. Both DuPont and Ellison are interested in the ways in which ciphering *reconfigured* writing and, consequently, reading and interpretation, creating new combinatory practices that would influence the history of computing. Ellison sees this reconfiguration as shaping the way that human cognition has been conceptualized up through the twenty-first century. Kim and Mittman look to early recombinations to find that "the cipher reveals the letters, those keepers of history, for what they are: abstract shapes with no organic or causal connection to the sounds they represent in words with no organic or causal connection to the meanings they represent."[61]

Stock's chronology of literacy may foreground the changing media of writing, but it also downplays the extent to which those media determine the types of communication that can be transferred on their surfaces. Lisa M. Barksdale-Shaw, in Chapter 6, focuses on the technology of the letter as it memorializes secrecy and at how letter-writing "disrupts communities and relationships."[62] Kim and Mittman note that the surface of whalebone or wood, for example, guides the carver to particular kinds of linear shapes and thus to particular kinds of ciphers, like runes. Paper, too, encourages the alphabetic—the flowing lines of ink across the soft, porous page—and it also enables communication by folding and tearing, whereas wood and bone do not. Even cases like the Newbold misreading of the Voynich manuscript, discussed in the afterword, reveal the significance of technological determination. Newbold imagined that the microscope was invented centuries before it really was in order to argue that tiny messages were traced within the elegant quill or brush strokes of other messages, ciphers within ciphers. Manly countered that Newbold had obviously forgotten the nature of the media he described: the movement of ink across a porous, uneven paper surface, if examined closely, creates valleys and elevations that can appear intentional and meaningful, like craters on the moon that look like human faces.

A Material History of Medieval and Early Modern Ciphers thus engages with existing ideas about old materialisms and emerging scholarship on new materialisms. In their recent anthology, Diana Coole and Samantha Frost argue that twenty-first-century economies, technologies, and environmental and geopolitical innovations require a new philosophy that can resituate the human within the material world. The economic, technological, political, environmental, and also theological and scientific cultures of the medieval and early modern world, which were just as dramatically changing as our own, also challenged citizens and thinkers to reconceive of the human in a world that they saw as increasingly more embodied and less connected to the immateriality of,

for example, angels.[63] The pivotal moment in Trithemius's instructions in *Steganographia* is when he requires that angels must be summoned to transmit ciphers. This invalidated his credibility as cryptographer, for many, yet secured his celebrity and mystery in the occult tradition. Yet the instruction is a trick: the angels' names are ciphers that reveal a hidden message within the third book, and presumably an insider audience known to Trithemius would have realized this. Similarly, Barksdale-Shaw considers moments of performative grandeur—like the presentation of ciphers as evidence in trials, or secret letter exchanges in Renaissance drama—that similarly question sovereign power and the authority which secret writing should be granted. Our volume thus looks specifically at how medieval and early modern thinkers conceived of human communication and the production, delivery, and interpretation of information deemed too important to be transmitted openly or visibly, of information that must hover across the line of materiality and immateriality—and exploit both—and that could impact the health, psychologies, and even survival of actual bodies. The new materialist dismantlings of binaries, like nature/culture or body/thought, are also familiar debates for medieval and early modern scholars. Interest in the fetishizing of objects, too, is relevant in the study of ciphers, which especially as unsolved puzzles have become the obsessions of specialists and amateur cryptanalysts alike.

Chapters here on orality, music, visual symbols, letters, gestures, tactile manipulations, and the adoption of ciphers in literary narrative return repeatedly to pattern recognition and (re)combination; the historical discipline of cryptography foregrounds questions of relationality that are similarly at stake in new materialist studies. This collection is, in this sense, about "the conceptual refinement of systems of representation," in DuPont's words.[64] When we consider that for writers like Wilkins, cryptography offers a starting point for his vision of a universal language that can directly express "things" in their true forms rather than through symbols, like alphabetic letters, that bear no real relation to what they signify, we see the ways in which ciphers demonstrate but also problematize the medieval and early modern skepticisms about abstraction. In the conclusion of his *Insistence of the Material: Literature in the Age of Biopolitics* (2014), Christopher Breu proposes that, more than "the sphere of theoretical production," the "impure resources of the humanities can be invaluable guides for helping us think through a workable posthumanism and a new relationship to the world."[65] Ciphering as it appears in the contexts considered in this volume pushes at the notion of the "impure" valuation of the material Breu reads in literature at the same time that it *also* requires abstraction, consciousness, and theoretical manipulation. In Chapter 7, for example, Wilde describes the debate within early modern geometry about the centrality of the "concrete properties of material bodies," revealing how that discipline

was consciously thinking through the spatial relationships of symbolic systems. Ciphering in the early medieval period occurs in the context of explicit discussion of language, but also of calculation, and in that sense suggests early recognition of the capacity of ciphering to span both. Similarly, during the early modern period, ciphering and its sister disciplines, like geometry, were promoted as art forms in which creative thinking and a flexible problem solving process were necessary. Wilde notes, for example, that even as he offers one ingenious option, William Oughtred emphasizes that there are many ways one might solve a single problem.

One of the ontological purposes of geometry is to express magnitudes beyond the power of human language to express. Ciphering during the medieval and early modern periods also offered a possible means of expression of the unspeakable—in many cases, it communicated what was too dangerous, and even deadly, to speak aloud or write visibly, and it was also posited as an answer for disconnection in the expanding global economy. In Chapter 10, Britland discusses Kenelm Digby's concept of "sympathie," which was the theory that invisible atomic vibrations create connections between distant bodies. It invoked a desire to heal wounds from afar, and ciphering served as a linguistic metaphor for, and even as a potential demonstration of, the possibility of curing human suffering across expansive geographies. Harris also finds, in Chapter 3, that Anglo-Saxon ciphers offered a means of participating in a transcendent order. Up through the seventeenth century, the ability to locate and decipher signs in nature, the Book of God, indicated one's closeness to heaven and eventual salvation. Christie develops this suggestion, in Chapter 4, and argues that ciphering could also involve an act of exegesis and authorization of higher meaning.

Yet even as ciphering provides a mode of delivering meaning more safely, it is also a means of rendering "words unspeakable," as Kim and Mittman point out. Under the guise of gibberish, or with characters or images that are not alphabetic and resist pronunciation, ciphers force silences into messages that are otherwise intelligible or manifest as objects that are wholly inaudible. Britland notes that in women's ciphered correspondence, secrets are *things* as well as *experiences*. The chapters in this volume also, then, record the ways in which cryptography is at once a system for understanding global neighbors and communities—and divine messages in nature—by creating a unique shared language independent of national or ethnic symbolic systems, and also a means of hiding communication from outsiders and from the unsaved. Women, in Britland's chapter, communicate with one another through cipher, yet women's bodies are also material representations of secrecy; men write ciphered letters under the guise of female authorship in order to avoid suspicion—a strategy that Britland finds does not always work. Clody suggests that gesture, used to communicate with indigenous populations, was simultaneously a means of forging partnerships and

a technology of colonial oppression. In academic exchange, too, Wilde discovers that Oughtred boasts a new way of teaching geometry yet still, as is common in the genre of the early modern textbook and the pedagogical manual, omits instructions or includes directions that are vague. Under the guise of sharing innovation, Oughtred keeps enough secret to protect his disciplinary dominion and the class boundaries of scholastic knowledge. And theologically, as Harris finds of Anglo-Saxon ciphers in verse, the "messages in the poems are secret not because they are hidden but because they both transcend and inform the baser language of secular, practical life."[66]

"Readers of secret writing must *begin* elsewhere," Kim and Mittman find.[67] Ciphers ask us to question *where* we find meaning and remind us that reading, not only of secret writing but of all writing, does not begin the moment one looks down at a page and begins to cognitively process alphabetic words in lines from left to right. Reading begins as soon as one considers the object that will be read, the materiality of the technology as it requires itself to be grasped, opened, traced over with a finger, flipped through, listened to, smelled, or tasted. Reading begins when one considers genre and assumes the conventions of that genre before approaching the content, such as when one consults a technical manual for exercises, searches a dictionary, or relaxes into a gothic novel ready for the narrative cues of suspense. The ciphers, and the acts of ciphering and deciphering, described in this collection challenge the narrative of reading, and the chronology of reading practices, that has dominated our histories of literacy. The Franks Casket, for example, asks those who gaze upon it to reconsider how they read text and image together on the same surface or upon the same object. This three-dimensional box not only defies linear reading: its self-reflexive references to its own materiality create a kind of viewer paranoia. Ciphers slow down and even arrest reading: they obstruct the speed but also the conventions by which readers believe they must operate according to the genres and surfaces of their experience of literacy. The early history of ciphering is, perhaps above all else, a history at once of literacies and of the de-naturalizing, exaggerating, materializing, and disrupting of the practices and the cultures that those literacies create and require.

Notes

1 Dorothy Crain and Helen Louise Ricketts, *Ciphers for the Little Folks: A Method of Teaching the Greatest Work of Sir Francis Bacon* (Geneva, IL: Riverbank Laboratories, 1916).
2 Ibid., 3.
3 Ibid., 6, 17.
4 Ibid., 4.
5 Alfred Dodd, *Francis Bacon's Personal Life-Story* (London: Rider and Company, 1949), 80.

6 Ibid., 80.
7 Bede, *The Reckoning of Time*, trans. Faith Wallis (Liverpool: Liverpool University Press, 1988, repr. 2004), 9, 11.
8 Erik Moltke dates such variability to the oldest runic inscriptions: "In the oldest runic inscriptions the direction of the writing is variable: sometimes left to right, sometimes right to left, sometimes bustrophedon…." In Erik Moltke, *Runes and Their Origin: Denmark and Elsewhere* (Copenhagen: The National Museum of Denmark, 1985), 32.
9 Michael P. Barnes, *Runes: A Handbook* (Woodbridge: The Boydell Press, 2012), 145–146.
10 Malcolm B. Parkes observes, "Although by the eighth century some scribes had begun to introduce word separation to assist direct lexical access, the process was not complete before the twelfth century." Malcolm B. Parkes, "Rædan, Areccan, Smeagan: How the Anglo-Saxons Read," *Anglo-Saxon England* 26 (1997): 1–22, at 2–3.
11 Katherine O'Brien O'Keeffe, *Visible Song: Transitional Literacy in Old English Verse* (Cambridge: Cambridge University Press, 1990), 4.
12 Ibid., 9.
13 Fletcher Pratt, *Secret and Urgent: the Story of Codes and Ciphers* (Garden City, NY: Blue Ribbon Books, 1942), 11.
14 Raymond I. Page, *An Introduction to English Runes*, 2nd ed. (Woodbridge: Boydell, 1973), 82.
15 *The Etymologies of Isidore of Seville*, trans. Stephen A. Barney, W. J. Lewis, J. A. Beach and Oliver Berghof (Cambridge: Cambridge University Press, 2006), 41.
16 Ibid., 52.
17 Dieter Bitterli, *Say What I Am Called: The Old English Riddles of the Exeter Book and the Anglo-Latin Riddle Tradition* (Toronto, ON: University of Toronto Press, 2009), 73.
18 Kari Anne Rand, "The Authorship of *The Equatorie of the Planetis* Revisited," *Studia Neophilologica* 87 (2015): 15–35, at 15.
19 Geoffrey Chaucer, "A Treatise on the Astrolabe," ed. John Reidy, in *The Riverside Chaucer*, ed. Larry D. Benson, 3rd ed. (Boston, MA: Houghton Mifflin, 1987), 1–5.
20 Bede, *Reckoning of Time*, (I.268), 9.
21 Isidore, *Etymologies*, (III.iv.4), 90.
22 Martin Irvine, *The Making of Textual Culture: "Grammatica" and Literary Theory, 350–1100*, Cambridge Studies in Medieval Literature 19 (Cambridge: Cambridge University Press, 1994, repr. 1996), 97.
23 Ibid., 97, 104.
24 Ibid., 21.
25 In addition to the three cryptic signatures identified in 1949 by Neil Kerr, a number of marginal notes have been attributed to Coleman. See for both a brief survey and recent identifications David F. Johnson and Winfried Rudolf, "More Notes by Coleman," *Medium Ævum* 79, no. 1 (2010).
26 Irvine, *Textual Culture*, 21.
27 Edward Nicholas, *The Nicholas Papers. Correspondence of Sir Edward Nicholas, Secretary of State*, ed. George F. Warner, vol. IV, 1657–1660 (London: Office of the Society, 1920).
28 Lois Potter, *Secret Rites and Secret Writing: Royalist Literature 1641–1660* (Cambridge: Cambridge University Press, 1989), 38–39.
29 Karen Britland, "Reading Between the Lines: Royalist Letters and Encryption in the English Civil Wars," *Critical Quarterly* 55, no. 4 (2014): 15–26; Sarah Poynting, "Deciphering the King: Charles I's Letters to Jane Whorwood,"

The Seventeenth Century 21, no. 1 (2006): 128–140; Nadine Akkerman, ed., *The Correspondence of Elizabeth Stuart, Queen of Bohemia*, 3 vols. (Oxford: Oxford University Press, 2011).

30 *The Diplomatic Correspondence of Thomas Bodley, 1585–1597*, accessed September 2, 2015 Centre for Editing Lives and Letters, www.livesandletters.ac.uk/bodley/images.html.

31 See Lawrence M. Principe, "Robert Boyle's Alchemical Secrecy: Codes, Ciphers and Concealments," *Ambix* 39 (1992): 63–74; Benedek Láng, "Ciphers in Magic: Techniques of Revelation and Concealment," *Magic, Ritual & Witchcraft* 10, no. 2 (2015): 125–141.

32 Cicco Simonetta, *Rules for Decrypting Enciphered Documents Without a Key* (Milan, 1474). Augusto Buonafalce has explained that Simonetta's rules describe methods that any clerk would have already understood. Augusto Buonafalce, "Cicco Simonetta's Cipher-Breaking Rules," *Cryptologia* 32, no. 1 (2008): 62–70.

33 John Wilkins, *Mercury; or, The Secret and Swift Messenger* (London: I. Norton for John Maynard and Timothy Wilkins, 1641).

34 See Marvin Colker, "A Discussion of Cryptography in a Late Medieval Codex," *Manuscripta* 15 (1971): 85–88; Lucie Doležalová, "On Mistake and Meaning: Scinderationes Fonorum in Medieval Artes Memoriae Mnemonic Verses, and Manuscripts," *Language and History* 52, no. 1 (2009): 26–40; Alf Monge, *Norse Medieval Cryptography in Runic Carvings* (Glendale, CA: Norseman, 1967); and Ole G. Landsverk, "Norse Medieval Cryptography in American Runic Inscriptions," *American Scandinavian Review* 55 (1967): 252–263.

35 Giovanni Soro, *Liber zifrarum* (Venedig, 1539).

36 See Mohammad Mrayati, Yahya Meer Alam, and M. Hassan At-Tayyan, eds., al-Kindi's Treatise on Cryptanalysis (Riyadh: King Faisal Center for Research and Islamic Studies, 2003); Mohammad Mrayati, Yahya Meer Alam, and M. Hassan At-Tayyan, eds., ibn'Adlan's Treatise al-mu'allaf lil-malik al-'Asraf (Riyadh: King Faisal Center for Research and Islamic Studies, 2004); Mohammad Mrayati, Yahya Meer Alam, and M. Hassan At-Tayyan, eds., ibn ad-Duryahim's Treatise on Cryptananalysis (Riyadh: King Faisal Center for Research and Islamic Studies, 2004); Mohammad Mrayati, Yahya Meer Alam, and M. Hassan At-Tayyan, eds., ibn Dunaynir's Book: Expositive Chapters on Cryptanalysis (Riyadh: King Faisal Center for Research and Islamic Studies, 2005); Mohammad Mrayati, Yahya Meer Alam, and M. Hassan At-Tayyan, eds., Three Treatises on Cryptanalysis of Poetry (Riyadh: King Faisal Center for Research and Islamic Studies, 2006).

37 Roger Bacon, *Friar Bacon His Discovery of the Miracles of Art, of Nature, and of Magick*, trans. T.M. (London: printed for Simon Miller at the Starre in St. Pauls Churchyard, 1659). All references will be to this edition.

38 Katherine Ellison, *A Cultural History of Early Modern English Cryptography Manuals* (New York: Routledge, 2016).

39 Jim Reeds, "Solved: The Ciphers in Book III of Trithemius's *Steganographia*," *Cryptologia* 22, no. 4 (1998), 291–317. It is worth noting that Trithemius's cipher was also solved two years prior to Reeds's more well known work, by Thomas Ernst in his 1996 dissertation at La Roche College in Pittsburg. See Thomas Ernst, *Schwarzweisse Magie. Der Schlussel zum dritten Buch der Steganographia des Trithemius* (Amsterdam: Rodopi Bv Editions, 1996).

40 Jacopo Silvestri's *Opus Novum* (1526), for example, is described as only the second book on cryptography in print, and Silvestri was hailed by Aloys Meister in 1906 as superior to Trithemius as a practical cryptographer. Yet,

the most recent scholarly work on him was by Philip M. Arnold in 1980. Jacopo Silvestri, *Opus Novum* (Rome, 1526); Aloys Meister, *Die geheimschrift im dienste der Päpstlichen kurie von ihren anfangen bis zum ende des XVI jahrhunderts* (Paderborn: F. Schöningh, 1906); Philip M. Arnold, "An Apology for Jacopo Silvestri," *Cryptologia* 4, no. 2 (1980): 96–103.

41 See Anthony Grafton, *Leon Battista Alberti: Master Builder of the Italian Renaissance* (New York: Hill and Wang, 2001); Franco Borsi, *Leon Battista Alberti: The Complete Works* (New York : Electa/Rizzoli, 1986); Kim Williams, *The Mathematical Works of Leon Battista Alberti* (Basel: Birkhäuser, 2010); Barry M. Katz, *Leon Battista Alberti and the Humanist Theory of the Arts* (Washington, DC: University Press of America, 1977); Joan Kelly, *Leon Battista Alberti: Universal Man of the Early Renaissance* (Chicago, IL: The University of Chicago Press, 1969).

42 *De Furtivis* was translated into French in 1606 as *Les Notes Occultes des Lettres*.

43 See Michael Clody, "Deciphering the Language of Nature: Cryptography, Secrecy, and Alterity in Francis Bacon," *Configurations* 19, no. 1 (2011): 117–142; Anthony J. Funari, *Francis Bacon and the Seventeenth-Century Intellectual Discourse* (New York: Palgrave Macmillan, 2011); Pete Langman, ed., *Negotiating the Jacobean Printed Book* (Surrey: Ashgate, 2011); James Dougal Fleming, ed., *The Invention of Discovery, 1500–1700* (Surrey: Ashgate, 2011).

44 Francis Bacon, *The Twoo Bookes of Francis Bacon. Of the proficience and advancement of Learning, divine and humane* (London: Printed for Henrie Tomes, 1605).

45 Francis Bacon, *De Dignitate & Augmentis Scientiarum*, in *Opera Francisci Baronis de Verulamio* (London: John Haviland, 1623); first translated into English by Gilbert Wats as *Of the Advancement and Proficiencie of Learning* (Oxford: Leonard Lichfield, 1640). References to *Advancement* are from this 1640 English edition.

46 P. Gasparis Schotti, *Schola steganographica, in classes octo distributa* (Nuremberg, 1665).

47 Delia Bacon, *The Philosophy of the Plays of Shakspere Unfolded* (London: Groombridge and Sons, 1857), x.

48 Christie, 90.

49 David Kahn, *The Codebreakers: The Comprehensive History of Secret Communication from Ancient Times to the Internet Revised and Updated* (New York: Scribner, 1996), 156. Kahn's study was first published in 1967.

50 Thomas Usk's *Testament of Love* was printed in William Thynne's 1532 Chaucer edition, but Usk scholars tend to use *Chaucerian and Other Pieces*, ed. Walter W. Skeat (Oxford: Clarendon Press, 1897), ii. 286 b/1.

51 The term "cipher" also frequently referred to the ornamentation of lettering that appeared in highly decorated manuscripts and prints. Ciphers, as elaborate monograms, were intertextural designs that could hide the alphabetic character. Like the ciphers we explore, these typographic ciphers also revealed their meanings only within the context of the full word or sentence.

52 Brian Stock, "Toward Interpretive Pluralism: Literary History and the History of Reading," *New Literary History* 39 (2008): 389.

53 Brian Stock, *The Implications of Literacy: Written Language and Models of Interpretation in the Eleventh and Twelfth Centuries* (Princeton, NJ: Princeton University Press, 1983): 4.

54 Ibid., 18.

55 Ibid., 18.

56 Wilde, 154.

57 Britland, 217.
58 Tim Morris, "Cowley's Lemmon: Secrecy and Interpretation in *The Mistress*," *English* 60, no. 228 (2011): 35.
59 See Edward F. Hulme, *Cryptography; or the History, Principles, and Practice of Cipher-Writing* (London: Ward, Lock and Co. Limited, 1898); Helen Fouché Gaines, *Cryptanalysis: A Study of Ciphers and Their Solution* (New York: Dover Publications, 1989). Originally published in 1939; Laurence D. Smith, *Cryptography: The Science of Secret Writing* (New York: Courier Dover Publications, 1955); Simon Singh, *The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography* (New York: Anchor Books, 1999); Fred B. Wrixon, *Codes, Ciphers, Secrets, and Cryptic Communication: Making and Breaking Secret Messages from Hieroglyphs to the Internet* (New York: Black Dog & Leventhal Publishers, 2005); John A. Nagy, *Invisible Ink: Spycraft of the American Revolution* (Yardley, PA: Westholme, 2009).
60 DuPont, 96.
61 Kim and Mittman, 58.
62 Barksdale-Shaw, 119.
63 Diana Coole and Samantha Frost, *New Materialisms: Ontology, Agency, and Politics* (Durham, NC: Duke University Press, 2010). See also Rick Dolphijn and Iris van der Tuin, *New Materialism: Interviews & Cartographies* (London: Open Humanities Press, 2012).
64 DuPont, 97.
65 Christopher Breu, *Insistence of the Material: Literature in the Age of Biopolitics* (Minneapolis: University of Minnesota Press, 2014), 197–198.
66 Harris, 74.
67 Kim and Mittman, 58.

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1 Medieval Musical Notes as Cryptography

Elsa De Luca and John Haines

For most of the period of scientific research on medieval music, which is to say the last 200 years or so, the music notation of the Middle Ages has been studied primarily to elucidate, decode, or recreate past performances of songs—from the exact pitches of melodies[1] to their general outlines,[2] from the rhythms used by singers[3] to their vocal mannerisms.[4] In other words, notation has been treated as the medieval equivalent of a modern score. Seldom have these signs been recognized for what they were in the Middle Ages: not just music notes in the modern sense, but also *figurae* intended to transmit meanings having little to do with the execution of this or that trope or motet.[5] What we might consider the extra meanings of the *nota* were in fact primary meanings in medieval semiotics, to use an expression favored by Leo Treitler, meanings that ranged from straightforward symbolism to esoteric ciphering.[6] True, medieval writers do attest to musical notation being written for the practical purposes usually advocated by musicologists: to cite Guido of Arezzo, so that a "studious person may learn the chant by means of it."[7] But medieval writers also speak of musical notes' other functions, of their being shaped after things divine, for example, of individual notes as lacking perfection (*perfectio*), or of groups of notes as having different kinds of properties (*proprietates*)—all three citations, incidentally, found in no less obscure a source than Franco of Cologne's *Ars cantus mensurabilis* (*c.* 1270).[8] Rather than in some remote medieval corner, then, the "total reading" of the medieval musical note as a fully symbolic and esoteric thing can be found in the mainstream of music writing, and this all through the Middle Ages, from the Carolingian *pneuma* to Baude Cordier's heart-shaped puzzle.[9]

Strongly connected to these "other" functions of the *nota*, musical ciphers of the Middle Ages are regrettably understudied. In this chapter, we begin with a survey of the small body of scholarly literature devoted to the topic, which will help explain exactly why the phenomenon of medieval music ciphers is still relatively unknown. In the second part, we will look at three cases of this writing. Hopefully, future scholars will extend our research on this fascinating medieval phenomenon and, even more hopefully, discover a few more cases of medieval music ciphers.

Just how widespread music ciphers were in the Middle Ages, we will never know. Like much secret writing, but unlike the famous deluxe parchment anthologies of the Middle Ages, their written supports were either perishable or never displayed in public, or both, beginning with the ubiquitous medieval wax tablet.[10] Ninety-three sources from the Middle Ages are presently known to contain cryptographic neumes, but likely many more than these were written out on perishable supports like wax tablets or parchment rolls that have not survived.[11] For the time being, what we know about medieval musical cryptography is confined to Spain, since the vast majority of extant musico-cryptographic writing is found in Visigothic notarial deeds.[12]

In discussing medieval music ciphers, we must begin with the basic building block of music writing of the Middle Ages: the *nota*. This term, used often by music writers in the medieval period, retains its basic medieval ambiguity in one of the most famous passages in music history, found in Charlemagne's *Admonitio generalis* from 789. "So as to have a school of literate boys," Charlemagne writes, "maintain psalms, notes (*notas*), songs, computus and grammar in every monastery and restore well the Catholic books."[13] The term *notas* here may mean "musical notes" as usually assumed by music historians, but it could just as easily refer either to the ubiquitous Tironian shorthand notes or to any kind of "sign in writing," as Paul Dutton translates it.[14] In the Middle Ages, the term *nota* had a very wide semantic field indeed. In practice, medieval *notae* included rational writing systems such as the Tironian notes, as well as irrational ones. The latter ranged from smaller *characteres* such as the signs of the *Picatrix* to full-blown drawings such as the elaborate *figurae* of the *Ars notoria*.[15] It bears emphasizing that the two basic *notae* of music, the dot-like *punctus* and the stroke-like *virga*, were graphically identical to signs used in other systems of *notae*, most famously the stroke and dot of Tironian notes. Thus, in the Middle Ages, the musical *nota* belonged to a large family of notes and, in outward appearance at least, was much like any other medieval *nota*. Into this multifarious tribe of *notae* was born the cryptographic neume. To date, a proper study of the musical note in this broader notational context has not yet been undertaken.[16]

Scholarly Squabbles

As is the case so often in medieval studies, for musical cryptography, we must go back to the work of a handful of late-nineteenth-century researchers. Prominent art historian and director of Madrid's Museo de Reproducciones Artisticas Juan Riaño[17] would later claim that Manuel de Goicoechea, a librarian at the Biblioteca de la Real Academia de la Historia in Madrid, first alerted him to the phenomenon around 1860, even though José Foradada, head librarian at Toledo's

Archivo y Biblioteca Capitular, was the first to publish on it in 1867.[18] Curatorial quibbles aside, Foradada's 1867 article, published in the wake of the creation of the Escuela Superior de Diplomática in 1856, was a landmark ground-breaking four-page report on a phenomenon that Foradada deemed "of major importance": the presence in certain tenth- to twelfth-century manuscripts housed in the Archivo Histórico Nacional in Madrid of musical notes ("pneumas ó signos musicales") used as ciphers.[19] Over a decade after the appearance of Foradada's four-page notice, in 1881, paleographer Jesús Muñoz provided some examples of these curious inscriptions, including the striking cartouche from MS 22 of the Archive of León Cathedral (Figure 1.1). Muñoz saw a close resemblance of the musical ciphers to the alphabetic letters of Visigothic script, and he laid out ciphers and letters side by side in a comparative table to demonstrate this—the liquescent *pes* next to the letter L, the *torculus* next to M, and so on (see Table 1.2 as an example of this).[20]

It was the aforementioned Riaño who, a few years after this, turned this innocent curiosity about ciphers into a musicological controversy. In the preface and appendix to his *Critical and Bibliographical Notes on Early Spanish Music* (London, 1887), Riaño built on Foradada's suggestion by stating that the ciphers, which were clearly Visigothic music neumes, had in fact originated in alphabet letters, and furthermore that this could be said of Visigothic music notation in general: that the entire Visigothic notational system was based on the alphabet letters of Visigothic script. This in turn demonstrated, Riaño maintained, that the scribes of Spain, but not those of Carolingian France as some of his French academic competitors had claimed, were the creators of the earliest music writing system in the West.[21] Riaño's patriotic declarations had the effect of hijacking the topic of cryptographic neumes in the service of a question that had been preoccupying music historians for decades before him and that has unfortunately continued to do so to the present day: the genesis of music notation in the West. And, as a result of this, the logical step at the time, making a basic tally of the manuscripts that contained these ciphers, was never accomplished since music historians were too busy countering Riaño's hypothesis—incidentally, neither provable nor disprovable—of the Spanish origins of notation. Making matters worse, the three authors just discussed had only cryptically alluded to the sources they were consulting. In his landmark article, Foradada had mentioned only one manuscript (Archive of León Cathedral, MS 22, listed in Table 1.1)[22] and Muñoz just spoke of "a codex by Saint Isidore from Leon" and unspecified "different documents from the tenth to the twelfth centuries"[23]; as for Riaño, the only reference he provided was that his facsimiles were "taken from documents … existing in the Archivo Histórico, Madrid."[24]

The few subsequent publications expended their energies on laying waste to Riaño's assertion of Spanish primacy. Two years after his *Critical*

and Bibliographical Notes appeared, French monk André Mocquereau refuted Riaño in the first volume of the prestigious *Paléographie musicale* (1889). Mocquereau, the scientific leader of the Solesmes chant movement, reproduced the dozen inscriptions straight out of Riaño's appendix—remarkably for the famously erudite monk, without consulting or even citing the sources themselves.[25] And how could he? No one thus far had provided more than one lone manuscript shelf mark![26] Nevertheless, Pothier and Mocquereau were adamant: neumes did not originate in Visigothic letters, and Spain had not created medieval music writing. A few decades later, in a musical paleography handbook widely read at the time, the Montserrat monk Gregorio (Grégoire) Suñol upheld the two French scholars' theory of music notes originating in accentuation signs. As for the curious cryptography, Suñol insisted, to attempt to link alphabet letters and neumes was "to see resemblances where none exist"; there was no genealogical link between the "specialist writing of diplomas and charters" and the "neumes of musical writing."[27] Interest in the phenomenon was waning fast, and by 1955, musical cryptography was deemed "a little innocent game (*petit jeu innocent*) that lasted roughly three centuries and remained confined to the particular domain of notaries and other public scribes."[28]

Despite the recent revival of cryptographic studies in Spain,[29] the medieval phenomenon of musical cryptography remained unstudied until Elsa De Luca's research a few years ago on the León Antiphoner (León, Archivo de la Catedral, 8 in Table 1.1), where she stumbled onto two cryptographic inscriptions.[30] In decrypting these inscriptions, she established a new (and much earlier) date for the Antiphoner (900–905) and reconstructed its early history and changes of ownership.[31] De Luca then used these ciphers as a starting point for further study on the phenomenon of medieval musical notes as cryptography. By cataloguing the sources and studying their basic paleography—specifically, the exact shapes of individual ciphers, and the differences between scribal hands—she explored Visigothic musical cryptography more thoroughly than had been done until now and fulfilled a longstanding scholarly desideratum.[32]

Extant Sources of Musical Cryptography

The extant corpus of medieval sources with musical notes as cryptography dates from the tenth to the twelfth centuries and is comprised exclusively of Visigothic sources, as mentioned earlier. Among the 93 known sources, four stand out for their importance, as they are the only examples of cryptography found in liturgical books, while all the other sources are charters.[33] Cryptography firmly belonged to the world of notarial deeds, where it was used to serve two main functions: to write scribal subscriptions (e.g. "Petrus notuit") and to render in monogram form a high-ranking person's name.[34]

In the Visigothic era, the majority of the population was illiterate, and written culture was almost exclusively the prerogative of the clergy, who also acted as public notaries.[35] There is no evidence of a layperson writing a charter. Scribes typically signed as *presbiter*, *sacerdos*, *diaconus*, or *subdiaconus*, sometimes using the general label *clericus* or *monacus*.[36] It is important to emphasize that there were also different kinds of scribes, based on the origin and nature of their scribal training.[37] Not all Visigothic scribes were capable of writing and understanding cryptography. Instead, cryptography seems to have been an elitist code used only by skilled and very well trained notarial scribes. Their use of musical ciphers in charters acted both as a distinctive mark of their "high culture" and as a kind of protection against forgery, since very few people could understand them. Furthermore, from a purely calligraphic point of view, cryptography was a way of making a scribal signature stand out from the rest of the document because it was the last text written and was set off from the previous text.[38]

Beyond the notarial documents just discussed, the use of cryptography in liturgical books follows a slightly different pattern of usage. Its presence in these manuscripts seems to be due to the random acts of solitary scribes who wanted to leave a message using a writing code that could only be understood by a limited number of people. In the four surviving liturgical sources listed in Table 1.1, cryptography is used for various reasons: to leave a mark of possession (León, Archivo de la Catedral, 22), to celebrate the patron of the manuscript (León, Archivo de la Catedral, 8), to notate certain words of the Gospel reading (León, Archivo de la Catedral 6), and to provide the title of an epistle (Madrid, Biblioteca Nacional, 10007).[39] The examination of the date, provenance, and contents of these manuscripts suggests that the addition of musical cryptography in codices was indeed restricted to a specific geographical, chronological, and cultural milieu, that is, the León area *c.* 902–920. There is no explanation for the presence of musical cryptography in liturgical manuscripts of such a limited chronological and geographical scope. However, a possible explanation could be the fact that cryptography could only be learned and practiced in major scriptoria, and León was the only significant urban center in Northern Spain in this period, the others being primarily rural and under constant threat of Moorish attacks. Moreover, monastic communities in the León area at the turn of the ninth and tenth centuries were not independent institutions under the sole control of their abbot, but rather under the jurisdiction of the Bishop of León, upon whom they formally depended and whose ordo they followed—the ordo of their metropolitan see, that is, the Cathedral of León.[40] Based on these facts and the surviving evidence, it could be argued that the addition of musical ciphers in Visigothic liturgical manuscripts was an idiosyncratic phenomenon, possibly originating with a single scribe within the León diocese and spreading through the circulation of liturgical books among monasteries and churches in and surrounding that metropolitan see.

Table 1.1 A selection of medieval sources with music notes as cryptography

Source	*Date*
León, Archivo de la Catedral 6, fol. 3v	920
León, Archivo de la Catedral, 8, fols. 128v and 149r	900–905
León, Archivo de la Catedral, 21	25/12/989
León, Archivo de la Catedral, 22, fol. 90r	*c.* 840[1]
León, Archivo de la Catedral, 154	31/01/992
León, Archivo de la Catedral, 157-B	28/02/994
León, Archivo de la Catedral, 163	15/12/1001
León, Archivo de la Catedral, 257	06/12/1070
León, Archivo de la Catedral, 302	19/08/1022
León, Archivo de la Catedral, 921	25/04/1030
León, Archivo de la Catedral, 1340	06/12/960
León, Archivo de la Catedral, 1366	25/01/1082
Madrid, Archivo Histórico Nacional, Clero 884/16	21/09/1081
Madrid, Archivo Histórico Nacional 884/21	18/09/1082
Madrid, Biblioteca Nacional, 10007 fol. 207r	902

[1]The manuscript was written in Cordoba, but the cryptography was added by Monk Samuel after the manuscript was brought to León *c.* 900.

A study of the existing Visigothic documents containing musical cryptography shows that specific symbols were commonly used to represent given letters of the alphabet (see Table 1.2). However, like its Tironian cousin, despite a basic common cryptographic alphabet, musical cryptography did not play out in scribal practice as a uniform system. Instead, the shape and choice of ciphers used to represent each letter of the alphabet changed according to the scribe's flair and talent. In some cases, scribes used more than one cipher to represent the same letter of the alphabet within the same cryptographic inscription, making its deciphering more difficult. Occasionally, scribes wrote the ciphers transversally to create further complexity. Another complicating factor was that in musical cryptography, the letters of the alphabet could be replaced by both neume shapes and other non-neumatic signs. The latter were neither neumes nor letters but distorted representations of text letters made in the style of musical notes.[41] To further muddy the waters, sometimes a cryptographic inscription even included genuine text letters.

Medieval music notes as cryptography offer exceptional cases of how scribes were able to adapt musical signs in non-musical contexts.[42] There is no direct evidence of exactly when or how this phenomenon of cryptography originated, but it is possible to hypothesize based on who used musical cryptography and where in the surviving cartulary sources. Since scribes of charters could be either clerics or monks, we can infer that they were familiar with liturgical books and ultimately, with the notation found in these books.[43] This familiarity with the musical signs of liturgical books is indeed the key to explaining the use of medieval music notes in the cryptography found in charters. Probably at some point,

Table 1.2 Cryptographic alphabet used in León, Archivo de la Catedral, 22 (see Figure 1.1)

Medieval music notes as cryptography						*Distorted medieval music notes as cryptography*					
B	D	E	G	I	L	A	C	D	F	H	I
											
M	N	O	R	S	T	P	Q	R	T	U/V	X
											

these scribes of charters, also accustomed to reading and notating liturgical manuscripts, elaborated a creative writing code in which certain neume shapes that already resembled Visigothic text letters "became" those letters (e.g. G, M, and S in Table 1.2). Then, to complete their innovative code, they simply invented the remaining letters needed by "distorting" other neume shapes to fit their purpose. Whatever the origin of cryptography, pending future discoveries in non-Iberian sources, it seems from the extant evidence that musical cryptography was a hallmark of Visigothic culture.

Why presumably exclusively Visigothic is not at all clear, but the cases of two scribes, Munio of Sahagun and Juan of León, will shed some light on the context hypothesized in the previous paragraph. Presbiter Munio worked in the monastic scriptorium of Sahagun between 1102 and 1115, and he was capable of reading cryptography. He wrote a digest of ninth-century documents and charters that is also the last known extant dated manuscript written in Visigothic script. In the digest, Munio translated into Visigothic script all the cryptography he came across in the ninth-century charters he was copying.[44] By contrast, Juan of León finished the so-called *Tumbo Legionense* in 1124, in Caroline. The *Tumbo Legionense* is a digest of ancient charters. Evidently, Juan had difficulties reading tenth-century documents in Visigothic script. In fact, he seems to have not understood cryptography at all: in the *Tumbo Legionense*, Juan omitted all the cryptographic passages found in the original documents he was copying.[45] Archival evidence demonstrates that cryptography gradually fell into disuse during the twelfth century, at which time Caroline began replacing Visigothic script and scribes gradually lost the ability to write and understand cryptography.

Three Examples

The examples presented in this section were chosen because of their variety within the spectrum of surviving documents in musical cryptography as tallied in Table 1.1. The first case is one of the more elaborate that has survived, and it has even appeared in several modern paleography manuals: a red cartouche filled with cryptographic neumes found in a codex of miscellany, León Cathedral, 22 (Figure 1.1).[46] As seen in Figure 1.1, the cartouche opens with the book speaking in the first person: "Sanctorum Cosme et Damiani sum liber in territorio Legionense."[47] The self-named author of this inscription is a "Monk Samuel" who, as the opening of the cryptographic memorandum states, wrote this book belonging to the monastery of Saints Cosmas and Damian, in the province of León, in the valley of Abeliar, near the river Torio. Elsewhere in the book, the same Monk Samuel made other inscriptions—in Visigothic script on top of fols. 1v, 15r, 33v–34v—stating that the book was brought from

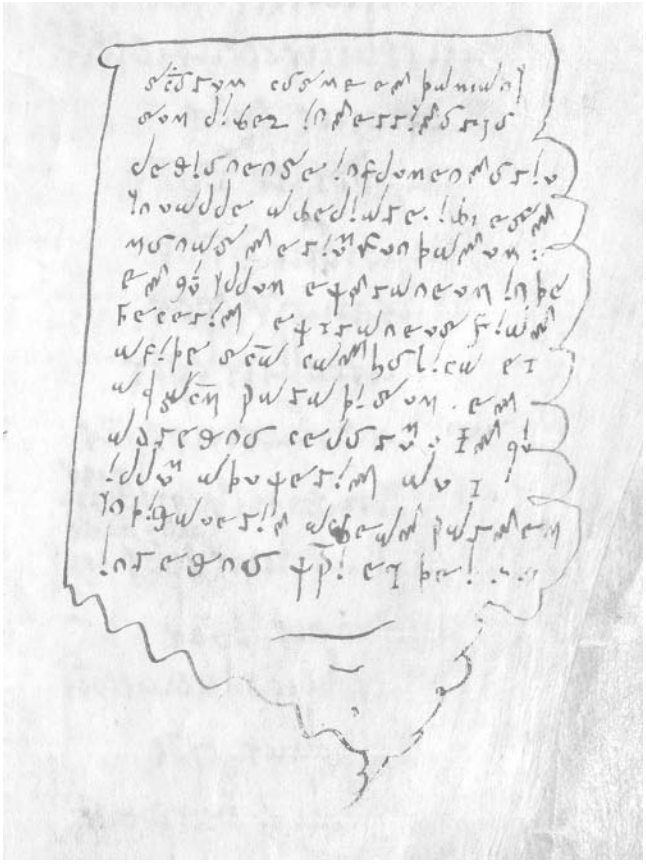

Figure 1.1 León, Archivo de la Catedral, 22, fol. 90r. Courtesy of the Archive of the Cathedral of León (Imagen M.A.S.).

Andalusia. On the whole, Monk Samuel's ciphers are fine calligraphy, written in red ink by a steady, elegant hand. The cryptographic cartouche specifically links Monk Samuel to the Monastery of Abellar, an important writing center in tenth-century León also believed to be the provenance of the entire León Antiphoner.[48]

One of the reasons for the relative popularity of the León cartouche is that it gives the illusion of musical cryptography as an elegant and somewhat straightforward code. This is misleading. As an illustration of the unsystematic nature of musical cryptography discussed earlier in this chapter, our second example comes from the second volume of a Bible, León Cathedral, 6 (Figure 1.2). The scribes Juan and Vimara left their signature on many folios of this book, which they wrote up in the Monastery of Santa Maria de Albares located west of León.[49] The

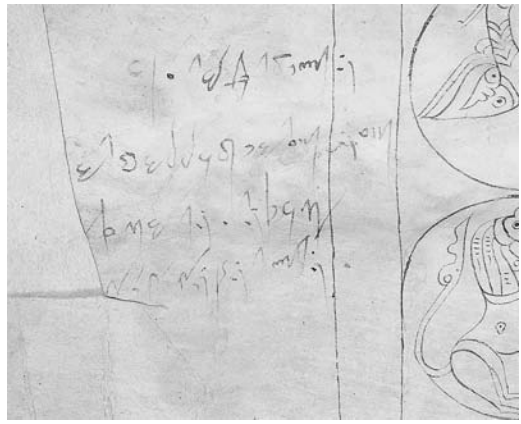

Figure 1.2 León, Archivo de la Catedral 6, fol. 3v. Courtesy of the Archive of the Cathedral of León (Imagen M.A.S.).

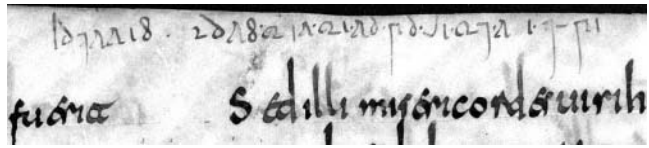

Figure 1.3 Madrid, Biblioteca Nacional, 10007, fol. 207r. Reproduced with permission.

cryptography is found on fol. 3v; here, Scribe Juan left his signature over a big miniature that was left unfinished ("Iubanes p ptrs scip amen memento"). The cryptography is written with the same ink as Juan's signature, so the former was likely also written by him. The meaning of the cryptography is unclear because of the many lacunae; as seen in Figure 1.2, the left border of the page is trimmed. The text appears to be the famous Gospel story of Judas' treason, although it does not match the Gospel accounts exactly.[50] The few ciphers found in this manuscript seem to be hastily written on a page that has been left unfinished; they do not show the same elegant calligraphy as Monk Samuel in our first example (Figure 1.1).

As a further example of the same kind of writerly inconsistency, our final example comes from a *Vitae Patrum* written in the León area by a team of scribes (Madrid, Biblioteca Nacional, 10007).[51] Generally speaking, this manuscript is poorer than the previous two sources in both parchment quality and calligraphic expertise. Similarly, the cryptography is deficient in calligraphic quality compared to our first two examples. Moreover, the ciphers on MS 10007 look rather different from

those used in the other examples. In particular, the choices of symbols for the letters A  , E  , O  , and S are very unusual. The scribe who added the cryptography in this case appears to have been a corrector or editor who used ciphers mainly to provide the names of various epistles' authors.[52]

Conclusion

As the three contrasting examples just discussed illustrate, even within the restricted geographic area represented by the extant sources, the phenomenon of musical cryptographic *notae* was quite a diverse one. The variety and even complexity of ways in which musical shapes were plied to cryptographic use certainly leaves room for further study, due to the dearth of modern attention described at the beginning of this essay. Indeed, the general revival of cryptographic studies in the past few years—as indeed represented by this very volume—can provide some basic groundwork for expanding our understanding of musical cryptography in the Middle Ages. Future research should persist in scouring Spanish archives, since more than likely one or two more examples of medieval musical cryptography remain to be discovered there. Visigothic scribes have not made these discoveries easy, creative as they were in finding new ways of obscuring the meaning of a text. Not only did they use musical notes as cryptography, as we have seen in this chapter, but also Greek letters to write Latin words, dots and lines to replace vowels, and Roman numerals to replace vowels.[53] Given the medieval scribal penchant for esotericism and creativity, the cryptographic codes that remain to be discovered by modern researchers will not come easily, but they will doubtless further enlighten our understanding of this fascinating medieval phenomenon.

Notes

1 Characteristic of nineteenth-century work on both monophony and polyphony; a summary is found in Friedrich Ludwig's 1905 lecture translated in John Haines, "Friedrich Ludwig's 'Medieval Musicology of the Future': A Commentary and Translation," *Journal of Plainsong and Medieval Music* 12 (2003): 129–164.

2 Mostly twentieth-century work on the "general outlines" of melodies, as I have put it, includes the philological-comparative approach and orality. A summary of these two for secular monophony is found in John Haines, *Eight Centuries of Troubadours and Trouvères: The Changing Identity of Medieval Music* (Cambridge: Cambridge University Press, 2004), 179–204 and 234–244.

3 The question of rhythm in vernacular monophony and polyphony was especially fashionable in scholarship from the early to the middle of the twentieth century. Haines, *Eight Centuries*, 210–234.

4 See Timothy McGee's *The Sound of Medieval Song* (Oxford: Clarendon, 1998).

5 One notable exception to this trend is Nancy van Deusen's *Theology and Music at the Early University: The Case of Robert Grosseteste and Anonymous IV* (Leiden: Brill, 1995).

6 A representative anthology of Leo Treitler's best-known essays is Treitler, *With Voice and Pen: Coming to Know Medieval Song and How It Was Made* (Oxford: Oxford University Press, 2007).

7 Guido of Arezzo cited (in translation) in David Hiley, *Gregorian Chant* (Cambridge University Press, 2009), 174.

8 Franco of Cologne cited (in translation) in Oliver Strunk, *Source Readings in Music History*, ed. Leo Treitler (New York: W.W. Norton, 1998), 229 and 234–235; see also John Haines, "On *Ligaturæ* and Their Properties: Medieval Music Notation as Esoteric Writing" in *The Calligraphy of Medieval Music*, ed. John Haines (Turnhout: Brepols, 2011), 213–220.

9 John Haines and Julien Véronèse, "*Nota* et *figura*: vers une lecture totale de la note musicale au Moyen Âge," in *Philologie et musicologie: des sources à l'interprétation poético-musicale (XII^{e}–XVI^{e} siècle)*, ed. Christelle Chaillou-Amadieu, Oreste Floquet and Marco Grimaldi (Paris: Classiques Garnier, 2017).

10 On wax and its use in music writing of the Middle Ages, see John Haines, "Manuscript Sources and Calligraphy" in *The Cambridge Companion to French Music*, ed. Simon Trezise (Cambridge: Cambridge University Press, 2015), 293–312.

11 On the use of parchment rolls to record songs, see John Haines, "The Songbook for William of Villehardouin, Prince of Morea (Paris, Bibliothèque nationale de France, fonds français 844): A Crucial Case in the History of Vernacular Song Collections," in *Viewing the Morea: Land and People in the Late Medieval Peloponnese*, ed. Sharon Gerstel (Cambridge, MA: Harvard University Press, 2013), 60–62, and Haines, "Aristocratic Patronage and the Cosmopolitan Vernacular Songbook: Bibliothèque nationale de France, f. fr. 844 and the French Mediterranean," in *Musical Culture in the World of Adam de la Halle*, ed. Jennifer Saltzstein (Leiden: Brill, forthcoming).

12 Generally on Visigothic chant, see especially Emma Hornby and Rebecca Maloy, *Music and Meaning in Old Hispanic Chants: Psalmi, Threni and the Easter Vigil Canticles* (Boydell and Brewer, 2013) and Suzana Zapke, ed., *Hispania Vetus: Musical-Liturgical Manuscripts from Visigothic Origins to the Franco-Roman Transition (9th–12th Centuries)* (Bilbao: Fundación BBVA, 2007).

13 Alfred Boretius, ed., *Karoli Magni Capitularia*, Monumenta Germaniae Historica, Legum, part two, Capitularia regum Francorum, vol. 1 (Hanover: Hahn, 1883), 60: "Et ut scolae legentium puerorum fiant. Psalmos, notas, cantus, compotum, grammaticam per singula monasteria vel episcopia et libros catholicos bene emendate."

14 Paul Dutton, *Carolingian Civilization: A Reader*, second edition (Peterborough, ON: Broadview, 2004), 92. See Kenneth Levy, *Gregorian Chant and the Carolingians* (Princeton, NJ: Princeton University Press, 1998), 243–245 and note 51. Regarding the famous passage, it is worth pointing out that there is no punctuation in the original source and that *cantus*, a fourth-declension noun, could be in the genitive rather than the nominative case; thus, the reading could be "notes of song" (*notas cantus*).

15 For a survey of rational and irrational medieval notes, see John Haines, *The Notory Art of Shorthand (Ars notoria notarie): A Curious Chapter in the History of Writing in the West*, Dallas Medieval Texts and Translations 20 (Louvain: Peeters, 2014), 1–31 and 60–67.

16 However, I have made a few preliminary attempts at this in recent published work (John Haines); see especially Haines, "On *Ligaturæ* and Their Properties" and "Manuscript Sources and Calligraphy."
17 Full name: Juan Facundo Riaño y Montero.
18 Juan F. Riaño, *Critical and Bibilographical Notes on Early Spanish Music* (London, B. Quaritch, 1887; repr. New York: Da Capo, 1971), 11; José Foradada y Castan, "Signaturas escritas con caractéres, considerados hasta aquí como pneumas ó signos musicales," *El Arte en España* 6 (1867): 105–109.
19 Foradada, "Signaturas," 105–107. These documents originated, Foradada states, in the Monastery of San Benito in Sahagún.
20 Jesús Muñoz y Rivero, *Paleografía Visigoda* (Madrid: Daniel Jorro, 1881), 77–81, foldout between pages 112 and 113, and plate XV.
21 Riaño, *Critical and Bibilographical Notes*, 15–20.
22 Foradada, "Signaturas," 109, plate 4.
23 Muñoz, *Paleografía Visigoda*, 124. In the 1919 edition of the same work (p. 134), Muñoz did add "(Signatura no. 22)" to "códice de San Isidoro de León."
24 Riaño, *Critical and Bibilographical Notes*, 103–108.
25 André Mocquereau (uncredited), *Paléographie musicale*, vol. 1, *Le codex 339 de la bibliothèque de Saint Gall* (Solesmes: Saint-Pierre, 1889), 36–39.
26 Foradada, "Signaturas," 107, note 1.
27 Gregorio Suñol, *Introduction à la paléographie musicale grégorienne* (Paris: Desclée, 1935), 315–316.
28 Louis Brou, "Notes de paléographie musicale mozarabe," *Anuario musical* 10 (1955): 32. Mention should also be made of a list of sources compiled around this time by paleographer Bernhard Bischoff in his "Übersicht über die nichtdiplomatischen Gehimschriften des Mittelalters," *Mitteilungen des Instituts für Österreichische Geschichtsforschung* 62 (1954): 14–15. Bischoff places musical cryptography within the broader context of medieval cryptography: systems using Latin alphabet letters, non-Latin letters, special signs other than letters (wherein fall musical neumes), and number systems. See my (John Haines) recent summary of Bischoff's article in Haines, *Notory Art of Shorthand*, 17–20.
29 Galende Díaz's contribution on medieval cryptography is limited to reiteration of previous scholarship. Juan Carlos Galende Díaz, "Elementos y sistemas criptográficos en la escritura visigótica," in *VIII Jornadas Científicas sobre Documentación de la Hispania altomedieval (siglos VI–X)*, ed. Nicolás Ávila Seoane, Manuel Salamanca López and Leonor Zozaya Montes (Madrid: Universidad Complutense de Madrid, 2009), 173–183.
30 The León Antiphoner is the most important Old Hispanic manuscript.
31 Elsa De Luca, "Musical Cryptography and the Early History of the 'León Antiphoner'," *Early Music History* 36 (2017): 1–54.
32 Ibid. De Luca also compiled a list with all the known documents containing music notes as cryptography. For each document are given: date, general contents, transcription of the cryptography and, if existing, bibliography (see De Luca, "Musical Cryptography," Appendix 2: 46–54).
33 The four manuscripts with cryptography are the first items listed in Table 1.1.
34 Monograms were tokens placed on documents, standing as symbols of official confirmation given by the person to whom the monogram belonged; however, monograms were rarely autograph. Instead, to make a document valid, it was enough to have the monograms written by the same scribe who wrote the rest of the document. Concepción Mendo Carmona, "La suscripción altomedieval," *Signo. Revista de Historia de la Cultura Escrita* 4

(1997): 207–229, 209–210, 221–222. A summary in English on monograms can be found in the section 'Monograms and signa in the Visigothic written world' in Elsa De Luca, "Royal Misattribution: Monograms in the León Antiphoner," *Journal of Medieval Iberian Studies* 9 (2017): 25–51. doi:10.1080/17546559.2015.110152. Available at www.tandfonline.com/doi/full/10.1080/17546559.2015.1101521.

35 Mendo Carmona, "Suscripción," 207–208.

36 José Antonio Fernández Flórez, "Los documentos y sus scriptores," in *Monarquía y sociedad en el Reino de León: de Alfonso III a Alfonso VII*, ed. José María Fernández Catón, 2 vols. (León, 2007), vol. 2, 97–140, 115.

37 The scribes who learned the art of writing in scriptoria annexed to a cathedral or an important monastery were more skilled than those who learned to write in a rural parish. Fernández Flórez, "Documentos," 115.

38 Mendo Carmona, "Suscripción," 226–227.

39 The cryptographies in manuscripts 6, 22, and 10007 are discussed in detail in the next section.

40 It was the king who promoted the institution of new monasteries to consolidate the frontiers of the Kingdom of León against the Muslims. After their creation, the king maintained an indirect control over the monasteries through the bishop of León, who was also nominated by the king. On the frontier monasticism in Castile, see José Avelino Gutiérrez González, "Castillos y sistemas de defensa en los reinos de León y Castilla," in *II Semana de Estudios Medievales, Nájera 5 al 9 de agosto de 1991*, ed. José Ignacio de la Iglesia Duarte (Instituto de Estudios Riojanos, 1992), 31–48, 33–35.

41 Someone not familiar with musical notation could have easily misjudged these "other signs" as authentic neume shapes.

42 Medieval music notes were also used to decorate initials and as punctuation marks in the León Antiphoner.

43 Old Hispanic musical notation has a striking rich set of graphical varieties for basic neume shapes and a great assortment of graphical elements placed near the notation (with the purpose of adding musical information). Given the complexity of this writing system, one can assume that a scribe capable of writing musical notation must have been skilled and well trained. See Elsa De Luca, "A Methodology for Studying Old Hispanic Notation; Some Preliminary Thoughts," in *Papers Read at the 17th Meeting of the IMS Study Group Cantus Planus Venice 2014*, forthcoming.

44 José Antonio Fernández Flórez, "La huella de los copistas en los cartularios leoneses," in *Orígenes de las lenguas romances en el reino de León: siglos IX-XII: Ponencias del Congreso Internacional celebrado en León del 15 al 18 de octubre de 2003*, 2 vols. (León: Centro de Estudios Históricos San Isidoro – Caja España – Archivo Histórico Diocesano, 2004), vol. 1, 159–227, 183–184.

45 Fernández Flórez,"Huella," 171, 191, 201. On the Tumbo, see José María Fernández Catón, "El Tumbo Legionense. Notas sobre su origen, redacción, estructura, contenido y utilización," in *Actas del IV Congreso Internacional de Latín Medieval Hispánico Lisboa, 12–15 de Outubro de 2005* (Lisboa: Centro de Estudios Clássicos, 2007), 415–435. Marta Herrero de la Fuente, "Cartularios leoneses: Del Becerro Gótico de Sahagún al Tumbo Legionense y al Libro de las Estampas," in *La escritura de la memoria: los cartularios. VII Jornadas de la Sociedad española de ciencias y técnicas historiográficas* (Huelva: Universidad de Huelva, 2011), 111–152.

46 On this manuscript and its cryptography, see Manuel Cecilio Díaz y Díaz, "El Manuscrito 22 de la Catedral de León," *Archivos Leoneses* 45–46 (1969):

133–168, Foradada, "Signaturas," 110–1, fig. 4, Galende Díaz, "Elementos," 179, Zacarías García Villada, *Paleografia Española*, vol. 1 (Madrid: Blass, 1923), 101, 161–164, 206, 213–214, Muñoz y Rivero, *Paleografía,* 134 and Riaño, *Critical and Bibilographical Notes*, 103–104, 107–108.

47 The full transcription of the cryptography is: *Sanctorum cosme et damiany sum liber in terrytorio legionense in flumen toriu yn ualle abeliare ibi est monasterium fundatum et qui yllum extraneum inde fecerit extraneus fiat a fide sancta catholica et ad sanctum paradisum et ad regno celorum et qui illum aduxerit aut yndigauerit abeat partem in regno christi et dei.*

48 De Luca, "Musical Cryptography," 34–40.

49 Vimara's signature can be found on fols. 2r, 233v. Juan instead signed fols. 3v, 91v, 202r, 211r, 216r, 217r. On fol. 101rv, there is an addition with the life of saint Froilán, Bishop of León (900–905) written by Juan (Joannes Diaconus scripsit). On this manuscript, see Ana Suárez González, "La Biblia Visigótica de la catedral de León (códice 6): primeros apuntes para un estudio arqueológico," *Estudios humanísticos. Historia* 10 (2011): 179–196, and Gloria Fernández Somoza, "La Biblia de León del año 920 en el contexto de la miniatura hispánica," in *Congreso Internacional "La Catedral de León en la Edad Media": actas; León, 7–11 de abril de 2003,* ed. Joaquín Yarza Luaces, Maria Victoria Herráez Ortega and Gerardo Boto Varela (León: Universidad de León, 2004), 499–507.

50 The cryptography reads: c?ina ? nocte / an gallus cante ??? / ?d mane in ebum / rir repente.

51 The manuscript can be dated to 902 because of the scribal subscription left on his last folio by Scribe Armentario. On this manuscript, see Manuel Cecilio Díaz y Díaz, *Códices visigóticos en la monarquîa leonesa* (León: Centro de estudios e investigación "San Isidoro" (C.S.I.C.), 1983): 117–148, Manuel Cecilio Díaz y Díaz, "Curiosidades Visigóticas," in *Mvnvs qvaesitvm meritis*: *Homenaje a Carmen Codoñer/ Tribute to Carmen Codoñer*, ed. Gregorio Andrés Hinojo and José Carlos Fernández Corte (Universidad De Salamanca: Ediciones Universidad Salamanca, 2007), 225–231, 226. On the cryptography in MS 10007, see Carlo Millares, *Tratado de paleografía española* (Madrid: Espasa-Calpe, 1983), vol. 1, 291, vol. 3, plate 463.

52 The cryptography reads: Ioannis constantinopolitani aep[iscop]i, while the Gospel is "illi Iesus amen dico tibi quia in hac nocte antequam gallus cantet ter me negabi" (Matthew 26.34).

53 Still the most authoritative survey of the various kinds of medieval cryptography is Bernhard Bischoff's "Übersicht über die nichtdiplomatischen Gehimschriften des Mittelalters" mentioned in note 28 of this essay.

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2 Keeping History

Images, Texts, Ciphers, and the Franks Casket

Susan Kim and Asa Simon Mittman

Medieval cryptography, as surveyed in David Kahn's enormously influential and invaluable study, *The Codebreakers*, flickers in an era of "cryptologic darkness" in which occasional surviving signatures or enciphered glosses nod to the complexity of earlier beginnings and later developments "like a single candle guttering in a great medieval hall."[1] While a few extremely complex encrypted texts survive, especially from the later Middle Ages—texts like the famous Voynich manuscript, for example—these encryptions are in fact not representative of the bulk of ciphered texts that have survived from the Middle Ages, and certainly not from the early Middle Ages. As Kahn and others have noted, the encrypted texts that have survived from the European Middle Ages do tend to be, as ciphers, simple: vocalic substitution ciphers, for example, or the dot or number ciphers described by both Isidore and Rabanus Maurus. For all that the basic mechanism of these substitution ciphers is simple, even "simple in the extreme,"[2] however, a surprising number of these texts do not resolve cleanly into plaintext. In this essay we consider two of these problematic ciphers and their contexts: the cipher on the right hand panel of the Franks Casket, and the interpolated cipher in Exeter Book Riddle #36. We do so taking as our point of departure a scribal note addressing the use of the substitution cipher written in the margins of one eleventh-century manuscript, the so-called Vitellius Psalter (Cotton Vitellius E.xviii): "Hit is lytel cræft; ac Þeah man mæg dwelian manega men mid ægðer ge ware ge unware" ("It is a trivial skill; nevertheless, one can deceive many men with it, both those who are aware, and those who are not.")[3] We acknowledge that these ciphers, as ciphers, are "lytel cræft" but consider as well that for all their apparent triviality, they are not simply games; as the Vitellius commentator observes, they can be effective against even—or perhaps particularly—the "ware," who might be inclined to dismiss them.

Riddle 36 appears in the context of the late-tenth-century collection of Old English poems, the Exeter Book. The riddles in this collection are highly literary enigmatic texts that range from the explicitly very serious (with "book" or "bible" as their proposed solutions) to the astonishingly crude (with "key" or "onion" as their proposed solutions, but

with "penis" or "erection" as their much more obvious answers). They are grouped with "wisdom literature," texts like the "Maxims," sets of gnomic verse, or Alcuin's educational dialogues, texts used to both preserve and transmit cultural "wisdom" and to train students in interpretation and in patterns of thought. They are about how we know things and what we call the things we know. Many of the riddles in fact end with the command, "Say my name" or "Say what I am called." In very simplified form, for example, in Alcuin's *Disputatio ad Pippini*, "Quid est littera" and its answer "Custos historiae" ("What is the letter: the keeper of history") fits into this tradition.[4] In the case of the more elaborate riddles, these patterns of thought include classification and also require the ability to recognize multiple simultaneous, though often quite contradictory meanings, one of which can be spoken aloud, and one of which, whatever its legitimacy, must be passed over in silence.

In the foreword to the 1993 revised edition of his translation, Kevin Crossley-Holland explains that from the 96 or so riddles in the collection, he has selected as many as possible—"all those that are not either very badly damaged or impossibly obscure."[5] Riddle 36, which does not appear in his edition, is not "very badly damaged." However, unlike many of the riddles with which it is bound, Riddle 36 remains without a clear "solution."[6]

The text, as it appears in the Anglo-Saxon Poetic Records edition, follows:

Ic wihte geseah on wege feran,
seo wæs wrætlice wundrum gegierwed.
Hæfde feowere fet under wombe
ond ehtuwe
monn h. w. M. wiif . m . x. l. k fw f hors. qxxs
ufon on hyrce;
hæfde tu fiþru ond twelf eagan
ond siex heafdu. Saga hwæt hie wære.
For flodwegas; ne wæs þæt na fugol ana,
ac þær wæs æghwylces anra gelicnes
horses ond mannes, hundes, ond fugles,
ond eac wifes wlite. Þu wast, gif Þu const,
to gesecganne, Þæt we soð witan,
hu þære wihte wise gonge[7]

I saw a creature travelling on the way.
It was splendidly, wondrously equipped.
It had four feet under the belly and eight
man hpmp/woman mxlkfpf horse qxxs
above on its back
It had two wings and twelve eyes
and six heads. Say what it was.

> It travelled the floodpaths, nor was it a bird.
> But there was the likeness of each of these:
> a horse, a man, a dog, a bird,
> and also the beauty of a woman. You know, if you know how
> to say, what we know is true,
> how things go for that creature.
> (Translation ours.)

Through a seemingly straightforward substitution for each vowel of the consonant that follows it in the Roman alphabet, the enciphered line, "man h p/w m p/woman m x l k f p/w f horse q x x s," can be read as "man homo woman mulier horse equus," very clearly an alternation between the Latin words for man, woman, and horse (homo, mulier, equus), and the Old English words for man, woman, and horse (monn, wif, hors). Already, then, the line suggests literate play across languages, moving between the two literary languages of Anglo-Saxon England, making a display of literacy in both languages and then exaggerating that literacy by the alphabetic manipulation of a vocalic substitution cipher.

In order to make the line come out so clearly as a substitution cipher, we have to slide around several inconsistencies. Krapp and Dobbie contend:

> It is evident that the scribe…, probably through inexperience with this form of writing, has jumbled his text considerably. In .h.w.M. the w is miswritten for p, and a second p has been omitted after M; in m.x.l.kf.w the w is miswritten for r; and the f before hors has been written in the wrong place and should follow hors.[8]

To make sense of the first claim, that in ".h.w.M. the w is miswritten for p, and a second p has been omitted after M," one needs to know that the Old English alphabet includes a few letters that are not part of the Roman alphabet, among them the letter *wynn*, which looks like a slightly pointier "p" and is used where Present-Day English transcriptions use the letter "w." According to Krapp and Dobbie, if the substitution cipher were to work "correctly," we should have H P M P WIIF. However, what appears is H W M WIIF.

As Fred Robinson's work with syntactic glosses has made quite compellingly clear, following the expected sequence of the Latin alphabet, the Anglo-Saxon alphabet included, with some variation, a number of additional letters, the sequence *wynn*, *thorn*, *ash*, *eth*, and even sometimes the *nota* and ampersand.[9] One way of approaching the cipher in Riddle #36, then, might be to consider that since no other "o" occurs in what is the likely plaintext (*homo, mulier, equus*), it is possible that this is a cipher which does not work by the expected alphabetic sequencing, and

in which *wynn*, not "p," replaces "o." If so, then, we might have "homo" in its entirety (h *wynn* m *wynn*). Working strongly against such a proposal, however, is the problem that the *wynn*-substituting-for-*o* of *homo* must then also serve as the *wynn* that is the first letter of *wiif* ("woman"). This problem underscores a central weakness of the vowel substitution cipher as a cipher. As Fletcher Pratt puts it, the vowel substitution already "violate[s] one of the cardinal principles of cryptography by making it difficult to tell a letter of the clear from an enciphered letter."[10]

The cipher's "violation" of "cardinal principles of cryptography" is thus brilliantly underscored at this juncture by two other violations of boundary: the Latin "*homo*" is monstrously joined to the English "*wiif*" as the boundaries of both word and language are transgressed in this moment of alphabetic promiscuity.[11] The second *wynn*, that is, must belong at once to the Roman alphabet (as the cipher for the "o" of homo) and to the Anglo-Saxon alphabet (as the first letter of the Old English word *wiif*). It joins a Latin word and an English one. It also conjoins words that represent fundamental categories of difference: man and woman.

This really could, of course, be just a mistake. But mistakes usually make sense: they work within the categories by which we know things. This moment of alphabetic promiscuity is also very like the "mistake" in the last words of the enciphered line. As Krapp and Dobbie note, "the f before hors has been written in the wrong place and should follow hors." If we do not simply "correct" or *change* the line, and if we take *f* for *e* and *x* for *u*, we have a sequence which places the Old English word *hors* inside the enciphered Latin *equus*.

In addition to the fact that the cipher works to create these moments of boundary confusion and violation, even in its hyper-literate-bilingual textuality, it also *arrests* the process of reading. Since, as noted above, many of the riddles in the Exeter Book end with some form of the demand, "Say what I am called," they require their readers to identify the speaking object that narrates the poem. Riddle #36, in contrast, draws out the problem of both posing and articulating a solution to the riddle. As Craig Williamson writes, "The cryptic line has only made solving the riddle more difficult."[12] But in addition, its final line, "Þu wast, gif Þu const to gesecganne, Þæt we soð witan…" ("you know, if you know how to say, what we know is true…") makes clear the difference between knowing something and knowing how to speak it, and it emphasizes again that the enciphered line, by taking out the vowels of the Latin, renders the words *unspeakable*. Especially given that Anglo-Saxon readers likely read aloud, even when they were alone, the moment of pause which the cipher creates, however briefly, before resolution into articulable language(s) thus also provides the opportunity for its readers to *stop* reading while continuing to look at the letterforms on the page, thus both to denaturalize and make visible the processes of reading and to separate the forms on the page from the spoken language it represents.

Figure 2.1 Lid, Franks Casket, Eighth Century, England. British Museum (London, England). Photo by Asa Simon Mittman.

Such intellectual play with language is not restricted to *pages* proper. The eighth-century whalebone chest we now call the Franks Casket similarly pushes us to consider the relationships across representational systems—across languages and alphabets, between images and texts, and between the ways we make meaning from each, and it does so most powerfully through its use of secret writing. The Franks Casket has engravings on all four sides as well as its lid (Figure 2.1). The four sides all also have inscriptions running around their edges as well as sometimes within the space of the images. The lid contains an inscription within the space of the image, and it is missing some framing panels that might also have contained inscriptions like those on the sides. The casket's images depict, wildly, episodes from Germanic mythological history (like the story of Weland the Smith), Christian narratives (the adoration of the Magi), and Roman mythology and history (the suckling of Romulus and Remus, the conquest of Jerusalem). The inscriptions not always but sometimes have what appears to be a direct relationship to the images. On the rear panel, for example, the inscription "Hic fugiant hierusalim" ("Here they flee Jerusalem") surrounds a scene that seems to involve fleeing figures. The various inscriptions are in Roman letters in different scripts, in Old English runes—forward, backward, and upside down—and in Latin, in Old English, and, on the right side, in some kind of substitution cipher (Figure 2.2). This is a remarkable diversity of writing strategies on an object that is less than nine inches in its longest dimension, and it attests to the strong drive in the literate, learned culture of

Figure 2.2 Right Panel, Franks Casket, Eighth Century, England. Museo Nazionale del Bargello (Florence, Italy). Photo by Asa Simon Mittman.

Anglo-Saxon England to explore the possibilities of written language by taking it apart and reconfiguring it in novel ways.

As R. I. Page notes, attempts at solution of the cipher are "too many, diverse, and improbable ... to discuss here."[13] But, and without entering into the debate too fully, we note that it is likely a vocalic substitution cipher of some kind involving variant or cryptic rune-like forms. Part of the difficulty in rendering the cipher has to do with the problem of how we understand the relationship between the texts and images. The texts on the back and left panels seem to be providing identification or explanation for the images they frame: "Romulus and Remus, two brothers," and "Here the inhabitants flee Jerusalem." It is difficult to reconstruct from the images on the right panel, however, the likely paramenters of a text that might identify this rather baffling sequence involving a bird-horse-snake-man hybrid, a warrior, a horse, and three hooded figures.

The fact of the existence of the cipher alone charges the way we approach the rest of the casket's images and texts. Thomas Klein has noted that the text of the back panel, "Her fegtaþ titus end giuþeasu HIC FUGIANT HIERUSALEM afitatores" ("Here Titus and a Jew fight Here the inhabitants flee Jerusalem"), not only includes both Old English and Latin, but it also moves between runic letters and, like many Anglo-Saxon manuscripts, both Roman and insular scripts, with the difference between the writing systems clearly emphasized.[14] As Klein observes, the letters of the Latin text are smaller than most of the runes. Also, in contrast to the runes, which are "firmly attached to the bases of their text boxes," the Latin letters "float in the relatively narrow rectangular space dedicated to them."[15] The alternation between the Roman majuscule and rounded

insular miniscule forms marks them as clearly different from each other and from the runic letters of the other texts.

The carving techniques used to render these framing texts, as well as the texts within the image on the right panel, are the same as those used to produce the casket's images. Both are produced with medium relief carving, slightly undercut at the edges to produce a floating effect. The sameness of material and technique creates a visual correspondance between text and image, and it therefore invites the viewer to enact a sort of transdisciplinary maneuver of reading images and viewing texts. This strategy, which we find in many Anglo-Saxon and insular works such as the elaborate incipit pages in insular Gospel books (Figure 2.3),

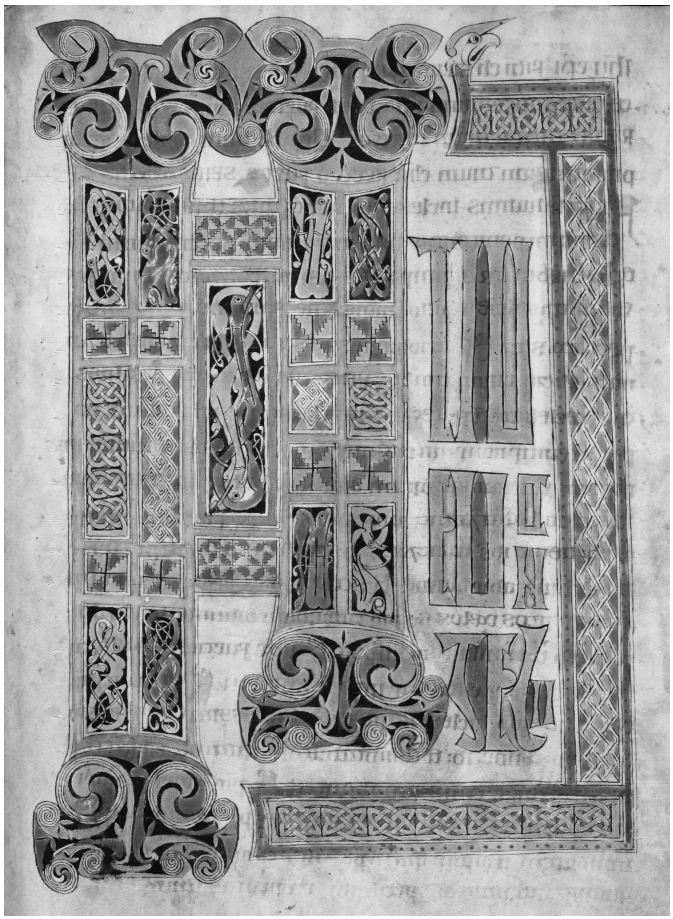

Figure 2.3 Irish Evangelary from St. Gall, Ireland, *c.* 750. Switzerland, St. Gallen, Stiftsbibliothek, Cod. Sang. 51, p. 79 (www.e-codices.unifr.ch). Reproduced under Creative Commons Attribution-NonCommercial 4.0 International License.

emphasizes and exaggerates the visuality of the text. The text of the opening of the Book of Mark in the St. Gall Gospels, for example, fuses together the first three letters of "Initium," turning them into a lively, pattern-filled form that not only invites a slow and close inspection but also so exaggerates the congruence of letter and image that it by necessity stops the reading process.

These first three letters are barely legible as letters, and we can only read them at all by predicting what the text should say. They might just as well be an "H," or perhaps an "O." They could read "Ibi" or "Idi" as easily as "Ini." Further, we cannot count the curious, interlacing beasts (eleven) nor follow the intricate lines of the knotwork panels *while* still reading the linear sequence of letters and words of the page in a meaningful way. Indeed, the nature of the forms used here even defies the reading of the letterforms as two-dimensional marks on a flat page: "even though ornament, and particularly interlace, is generally thought of as a linear art, it has the effect of imparting to the resolutely two-dimensional manuscript page a sense of mass and texture."[16]

The presentation of the texts of the casket similarly defies straightforward reading practices predicated on more common writing practices that facilitate the turn, in textuality, away from the materiality of the text. The casket's use of multiple languages (Old English, Latin), scripts (runic, Roman), carving techniques (one panel is incised while the rest are carved in relief), and orientations (upright, inverted, boustrophedonic, reversed) continually interfere with the reader's habits—particulary the "ware" reader's habits—of disregarding the *way* the text has been physically written as what might constitute textual meaning.

In Klein's argument, the marked and seemingly intentional differences between the script forms used on the casket index "the moment of encounter between several systems of writing, and the carver's conscious strategies for dealing with that encounter," in a demonstration of fluency and confidence in all of them.[17] Another way of reading Klein's thoughtful observations, however, might be to suggest that this *display* of textuality might also function, like other exaggerations, and like the "secret writing" of the cipher on the right panel, like the ornate, desconstructed letterforms of insular manuscripts, to make visible, and to challenge, the processes of representation it requires. That is, this demonstration of textual confidence requires participation in its systems for writing and reading (we need to know how those systems work, and we need to be part of the overlapping textual communities they reflect and create). At the same time, by making those same systems visible, this remarkable display of confidence also makes it possible to imagine reading and viewing differently.

Marijane Osborne, for example, taking into consideration the context of the right panel cipher (See Figure 2.2), draws our attention to the dots

in the lower inscription on the front panel and suggests their function as part of another cipher system, a common system involving the substitution of arrangements of dots for letters dating back to the Romans and described for the early medieval context in Rabanus Maurus's ninth-century *De inventione linguarum*. For Osborne, the likelihood that the dots in the casket inscription are functioning as ciphers is increased by their proximity to an odd figure in the image space, that thing that looks like a goose. In fact, she argues that the inclusion of the dots-as-cipher might change the word "gasric," usually translated as "powerful one" or "angry one" to a word that means something like "he who has power over geese/souls."[18]

To make that association, to suggest that the text is in interaction with the image, is not such an unusual claim—we make that argument all the time in the study of illuminated manuscripts. But on the Franks Casket, something perhaps more complex *is* going on with respect to the relationship of text and image. In a number of places, inscriptions occur within the space of the images. These can be quite useful, like the identification of the Magi on the front panel, or the naming of Aegili on the top. In a number of other places, however, there are runic inscriptions within the space of the images that are not so clearly marked off in a caption space, as on the front panel: in fact, in a few of these places, the inscriptions are very difficult to read even as text. On the rear panel, for example, the words "risci," "bita," and "wudu" are all but lost in the "wudu," the representations of wood, around them.

Once one is looking for text not only in the frames around the images, but in the images themselves, one can become accustomed to resolving these lines and curves into letters, and then into words. Tilghman argues that a central theme of the casket's complex text-image program is "the transformation of objects and the fashioning of matter into new things."[19] The writing processes wrought in the casket and the reading practices elicited by it suggest further forms of transformation and fashioning. The fact that many of the casket's letterforms and imageforms are structurally and stylistically indistinguishable invites us to approach the images *differently*, apprehending sequences, patterns, and repetitions as potential text to be deciphered for a textual meaning. Again, that brings us to the effects of the appearance of ciphers within texts and images. Many of the ciphers available in the early Middle Ages, in fact, are not letters or letterforms, or even sequences of dots, but forms that closely resemble images. These ciphers involved images of fish bones, trees, ships, and men with forked beards or pigs with lice. They work as ciphers by dividing each image into two sections, and then by marking one of the two by a section of the alphabet, and the other by a place within that section of the alphabet.[20] The hahal runes provide a very simple example of such ciphers: tree-like forms with a vertical and

"twigs" on either side marking the section of the runic alphabet and the place in the sequence within that section of the alphabet. Certainly, such runes survive in England, for example on the Hackness stone (eighth or ninth century).[21]

If, with cipher systems like the hahal runes or the dot ciphers in mind, however, we return to the Franks Casket and consider not only the obvious ciphers but also the many dots and squiggles—what have been called "meaningless curves used primarily as space fillers"[22]—we must consider that we may no longer separate the "image space" from the textual borders. We can consider the pattern of dots on the lid, the arrangement of arrows and their irregular fletching, and the sequences of tree trunks with sets of two or three roots on either side of the vertical, just as initial forays into this kind of examination. To be absolutely clear, we are not arguing that these dots and tree-like structures *actually are* (necessarily) an elaborate code or cipher. We are certainly tempted, and certainly interested in how such temptation works, but we are not proposing here an elaborate decryption of this puzzling object. We instead suggest that the integration of letters, letterforms, and the substitutions for letters—the integration of *text*, and particularly of *secret* writing, into the images of this object—is a powerful seduction to engage particular and particularly exaggerated *modes of reading*, and thus also an opportunity to see, and thus to re-consider, how we read images and texts, and how we do or do not attempt to "resolve" them into meaning.

In "Millions and Millions of Distinct Orders," Katherine Ellison argues that cryptographers in the seventeenth century exploited a "moment of encounter between several systems of writing," similar to the one Klein locates on our casket.[23] Ellison writes

> that cryptographers ... were not only conscious of the perceived competition between print and script but also capitalized upon that tension.... Secret writing forced readers to acknowledge their habits with texts, to see pages differently, to reprioritize what should be noticed, and to realize the blind spots created by contemporary conventions.[24]

In her reading of John Wilkins's *Mercury*, or, *The Secret and Swift Messenger*, Ellison considers, for example, Wilkins's "biform code" employing two different handwriting styles, but also codes manipulating "visual cues in spaces the reader would not be looking at while reading,"[25] for example the arrangement of dots which might blend into letterforms and images: "[e]ach point, if camouflaged as part of a letter or image, as stray ink between the lines, or even as reader marginalia, can blend into the spaces readers may overlook as they focus on the words

and images themselves."[26] Secret writing, that is, makes visible not only how, but also *where* we find textual meaning. By displacing meaningful symbols from the textual space proper into "spaces the reader would not be looking at *while reading*," that is, secret writing at once exaggerates and de-conventionalizes the process of reading: readers of secret writing move from the sequences of forms to the more conventional textual sequences they point to, and from there to meaning necessarily *elsewhere*. At the same time, readers of secret writing must also *begin* elsewhere, outside the spaces and forms proper to the text, and outside the now visible conventions of reading text. What does it mean to begin and end outside the ways we know and represent? What does it mean to make ourselves see the ways we know and represent, and to see the limitations of the categories of difference we maintain in order to do so? To comprehend such things about the ways we sustain our understanding of human intelligence?

A number of scholars have identified the text on the front of the Franks Casket as a riddle, like the literary riddles of the Exeter Book.[27] As a riddle, it was part of "a cacophony of things constantly chattering about themselves, not only through riddles, but also in the form of inscriptions on actual objects" to which "Anglo-Saxons were subject."[28] Especially given Klein's argument for the casket's display of *textual* confidence, considering the text on the front panel as a riddle is particularly provocative: unlike the literary riddles, like Riddle 26 (the "book" riddle), the riddle here turns not away from the materiality of the text, but rather, and insistently, back toward it, as the riddle's "solution." In the "book" riddle, the riddle takes the material, the animal, the "mec" deprived of life, as its *starting* point ("Mec feonda sum feore besnyþede" [a certain enemy came, deprived me of life]), from which it develops, from object to subject, into the "Ic" which speaks, which can demand that the reader/listener name it as the book ("Frige hwæt ic hatte" ["Say what I am called"]). In marked contrast, the casket riddle names not its transformation but what is perhaps its own material, *hronæsban*, as the "solution" to the riddle.

In this way, these two types of puzzle—the cipher and the riddle—both tilt in the same direction. They both stop us from reading as we would usually read and instead draw our attention to the mechanisms, the technologies through which we read. The cipher reveals the letters, those keepers of history, for what they are: abstract shapes with no organic or causal connection to the sounds they represent in words with no organic or causal connection to the meanings they represent. By replacing one letter with another, or replacing a known letter with a new and unknown one, the carver at once exaggerates and disrupts their function *as* letters. The Exeter Riddle, with its strange deconstruction and interlacing of words, and its enciphered letters serving as ligatures binding languages together, reminds us that this exaggeration and disruption is

not unique to the Franks Casket. However, the riddle carved into the bone of the front panel further estranges us from our inculcated and naturalized reading processes. It highlights its own material in a way that is familiar to historians of early medieval art (though perhaps less so to historians of language). Herbert Kessler stresses:

> Overt materiality is a distinguishing characteristic of medieval art. In most works, the substances used to fashion figures and ornament are apparent in ways that, say, the oil paint on a fifteenth-century Flemish panel or the marble of a Neo-classical sculpture are not. The materials do not vanish from sight through the mimicking of the perception of other things; to the contrary, their very physicality asserts the essential artifice of the image or object. Such typically medieval media as mosaic, stained glass, and enamel all demonstrate this point.[29]

So, of course, does whalebone. The casket's riddle stops our eyes from seeing only letters—enciphered or clear—and instead causes us to refocus our vision on the material out of which they were carved, on the bone, and on the delicate techniques used to bite and hew and chip it away until the glossy runic twigs stood out from the lightly textured background.

Focusing on the material of this inscription, however, also calls out a particular challenge not only to the processes of reading, but also to the understanding of the genesis of the letter itself. Many discussions of runic forms suggest that these forms were explicitly designed to be incised into hard surfaces like wood and bone, hence their exclusive use of straight lines. Erik Moltke, for example, observes that in general "letter shapes of an alphabet are determined by the material in which they are written or cut" and that runic forms with their vertical and diagonal lines "were designed to be carved in wood," the grain of which would make curved and horizontal lines difficult to read and to carve.[30] Michael Barnes has noted very clearly the circularity of this commonplace, however: it works on the argument that "the vertical, diagonal and angular lines" of many early inscriptions reflect the necessity of carving at an angle to the grain of wood and the greater ease of doing so without curves (the shapes show that wood was the material), but also that "since wood was the primary material, the first runes must have had a shape suited to working in that medium," that is, vertical, diagonal, and angular (because wood was the material, the runes took these shapes). As Barnes continues, the commonplace must also be considered with the provisos that wood is perishable, and most of the earliest inscriptions we have now are not on wood but on metal, and that a number of medieval inscriptions that are on wood survive with not angular but "beautifully rounded runes."[31] On the front of the Franks

Casket, just below the enframing inscription, is a secondary inscription on a small rectangular panel. Here, the runes are incised, as is far more typical than the relief carving of the other inscriptions on the casket. As the riddle is carved in relief, with a frame around it to emphasize its inversion, so the incised inscription is presented on a raised panel. The word of the relief inscription just above the incised panel, the word carved in this raised relief, is "ahof," that is, "*raised*," ensuring that the reader not miss the word-and-form play. If the material gives shape to the letter in its originary state, nonetheless, the letter can be, as it is here, shaped in absolute defiance of what is most congenial to the material: the exaggeration here is like the exaggeration of secret writing. The casket riddle makes visible the "blind spots created by contemporary conventions"—in fact, perhaps *the* blind spot of textuality: the turn away from the materiality of the sign. As the Vitellius annotator claims, "it is a trivial skill," but we hope not so easily dismissed for all that. In the early medieval contexts in which these "simple in the extreme" ciphers appear, so do explorations of and challenges to the ways we still do read, view, and know.

The Franks Casket, as the larger context for all this enigmatic writing and image making, is an object we can only identify in very rudamentary terms. Barnes has argued that for runic inscriptions in particular:

> it cannot be emphasized too strongly that runic inscriptions are much more than texts. The type of object bearing the inscription will often hold a clue to the interpretation of the message; size, shape and material can all influence layout; runes may owe their particular appearance, and words their spelling, to the condition of the surface into which the inscription is carved, and so on.[32]

But, as Benjamin Tilghman observes:

> we cannot even say for certain what many of our most famous [Anglo-Saxon] objects even are, or were intended to be. The Franks Casket, for example, has been identified as a treasure chest or a book shrine, and was used in the later Middle Ages as a reliquary, but all we can say with any certainty is that it is a box that likely originally had a latch.[33]

We do not know, that is, what the Franks Casket was designed to do, or what it did, in its context of production and early reception, beyond that it was "a box that likely originally had a latch," that it was used to hold and carry *something* in its secret interior. We propose here that one way the Franks Casket works through its cipher and its many gestures toward secret writing, however, is through externalizing that interior,

making its secrecy visible and public. The runic letters across the bottom of the front panel are backward and run right to left. While this reversal is in itself not terribly unusual, in this context, it presents the haunting possibility that we might read it, as we are accustomed to reading, if only we could do so from the *inside* of the box, somehow on the other side of representation, reading through the bone.

Notes

1 David Kahn, *The Codebreakers: The Story of Secret Writing* (New York: Macmillan, 1967), 89.
2 Kahn, *Codebreakers*, 89.
3 Frederick Tupper, Jr., ed., *The Riddles of the Exeter Book* (Boston, MA: Ginn and Co, 1910, repr., Darmstadt: Wissenschaftliche Burchgesellschaft, 1968), 155. Citations refer to the 1968 edition.
4 Alcuin, "Pippini Regalis et Nobilissimi Juvenis Disputatio cum Albino Scholastico," *Patrologia Latina* 101.0975.
5 Kevin Crossley-Holland, trans., *The Exeter Book Riddles* (London: Penguin, 1993), xix.
6 However, most editions conclude that probable solutions include "Man, Woman, and Horse" and "Ship." For example, Frederick Tupper, Jr., ed., *The Riddles of the Exeter Book*: 154–157; Craig Williamson, ed., *The Old English Riddles of the Exeter Book* (Chapel Hill: The University of North Carolina Press, 1977), 248–252; and George Philip Krapp and Elliott Van Kirk Dobbie, eds., *The Exeter Book* (New York: Columbia University Press, 1936), 341.
7 Krapp and Dobbie, *Exeter Book*, 198.
8 Ibid., 341.
9 Fred Robinson, "Syntactic Glosses in Latin Manuscripts of Anglo-Saxon Provenance," *Speculum* 48, no. 3: 443–475, 448–449.
10 Fletcher Pratt, *Secret and Urgent: The Story of Codes and Ciphers* (Garden City, NY: Blue Ribbon Books, 1942), 44.
11 Many thanks to Patricia Dailey for the early and invaluable collaboration on a paper on this riddle, "Dissolving Riddles, Reading Monsters," delivered at the 39th International Congress on Medieval Studies, Kalamazoo, May, 2004.
12 Williamson, *Old English Riddles*, 249.
13 Raymond I. Page, *An Introduction to English Runes*, 2nd ed. (Woodbridge: The Boydell Press, 1999), 178. For example, proposed by Marijane Osborne: "Here the hos sets upon the taster of harm./Affliction prevails, so that to her the earth-isle is a grave, /a sore den of sorrows and of torments to the mind." Marijane Osborne, "The Grammar of the Inscription on the Franks Casket, Right Side," *Neuphilologische Mitteilungen* 73, no. 3 (1972): 663–671. Earlier, Osborne proposed: "Here a group are situated on a hill of grief: Ægli is active, so that to them this earth-island is a grave, a wretched den of sorrows and of grief of mind." Marijane Osborn, "Two Inconsistent Letters in the Inscription on the Franks Casket, Right Side," *Neuphilologische Mitteilungen* 72, no. 1 (1971): 30–34. Christopher J.E. Ball proposed: "Here a group are situated on a hill of grief: affliction is active, as a grave, a wretched den of sorrows and of grief of mind." Christopher J.E. Ball, "The Franks Casket, Right Side," *English Studies* 47, no. 2 (1966): 119–126.

14 Thomas Klein, "Anglo-Saxon Literacy and the Roman Letters on the Franks Casket," *Studia Neophilologica* 81 (2009): 17–23.
15 Klein, "Anglo-Saxon Literacy," 17.
16 Benjamin C. Tilghman, "Ornament and Incarnation in Insular Art," *Gesta* 55, no. 2 (Fall 2016): 157–177, 175.
17 Klein, "Anglo-Saxon Literacy," 18.
18 Marijane Osborne, "The Picture-poem on the Front of the Franks Casket," *Neuphilologische Mitteilungen* 75, no. 1 (1974): 50–65.
19 Tilghman, 16.
20 Reykjaviík, Stofnun Árna Magnússonar AM 687d 4°. Page, *Introduction to English Runes*, 83.
21 Page, *Introduction to English Runes*, 83.
22 Philip Webster Souers, "The Wayland Scene on the Franks Casket," *Speculum* 18, no. 1 (1943): 104–111, 110.
23 Katherine Ellison, "Millions and Millions of Distinct Orders: Multimodality in Seventeenth-Century Cryptography Manuals," *Book History* 14 (2011): 1–24, 2.
24 Ibid., 2.
25 Ibid., 18.
26 Ibid., 2.
27 Carol Neuman de Vegvar argues for a reading of the Casket in the context of wisdom literature more broadly, "both in terms of structuring and transmission of information and as regards its context and possible larger messages," in Carol Neuman de Vegvar, "Reading the Franks Casket: Contexts and Audiences," in *Intertexts: Studies in Anglo-Saxon Culture Presented to Paul E. Szarmach*, ed. Virgina Blanton and Helene Scheck (Tempe, AZ: ACMRS/Brepols, 2008), 141–159, 147.
28 Benjamin C. Tilghman, "On The Enigmatic Nature of Things in Anglo-Saxon Art," *Different Visions: A Journal of New Perspectives on Medieval Art* 4 (January 2014): 2, accessed November, 2016, www.differentvisions.org/on-the-enigmatic-nature-of-things-in-anglo-saxon-art/.
29 Herbert Kessler, *Seeing Medieval Art* (Toronto, ON: Broadview, 2004), 19.
30 Erik Moltke, *Runes and their Origin: Denmark and Elsewhere* (Copenhagen: The National Museum of Denmark, 1985). Or, similarly, Raymond I. Page, *Runes* (Berkeley: University of California Press, and the British Museum, 1987): "Runic script was designed for inscribing, at first on wood, and it had appropriate characteristics" (6) and "Since runes were designed for incising on wood, the letterforms, in their earliest state, eschew curves, which are hard to cut in such a grainy material. Letters were made up of vertical strokes, cut at right angles to the grain, and of slanting strokes, which stood distinct from it. Horizontal strokes, which would mingle with the grain and be hard to distinguish, were avoided" (7). Or "As to variations in shape, it should be noted that the traditional angularity and absence of curves and horizontal strokes in runic characters was due no doubt to their initial use on wood; as other materials came to be employed for runic inscriptions, considerable formal modification, such as the use of curves and horizontal strokes, was liable to take place." Ralph W.V. Elliott, *Runes, an Introduction* (Cambridge: Cambridge University Press, 1957), 15.
31 Michael P. Barnes, *Runes: A Handbook* (Woodbridge: Boydell, 2012), 18–19.
32 Barnes, *Runes*, 4.
33 Tilghman, "Enigmatic," 1.

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3 Anglo-Saxon Ciphers

Stephen J. Harris

Literacy rates during the early Middle Ages were so low that writing itself was sometimes a means of concealing information. For those who could read, concealment ciphers were relatively primitive. Nevertheless, one finds examples of *steganography*, transposition ciphers, substitution ciphers, polyalphabetic ciphers, and other kinds of ciphers or secret writing among the Germanic-speaking peoples of northern Europe between the fall of the Roman Empire and the Norman Invasion. In the following pages, I review some examples of several types of concealed communication before asking why concealment might have been of more than practical interest to Anglo-Saxons.

Substitution ciphers replace one or more letters of a *plaintext* message with symbols or other letters, yielding a *ciphertext*. For example, one might replace the plaintext "abba" with numbers that represents each letter's position in the English alphabet, yielding the ciphertext "1221." This cipher may seem primitive, but during the early Middle Ages, it might also have been a xenocrypt—in other words, in a foreign language. After all, not all alphabets were similar. The Latin alphabet had at various times 17, 23, and 27 letters. The Hebrew alphabet has 22 letters and Greek, 24. Different again were the Gothic alphabet and the various runic alphabets of Anglo-Saxon England, Iceland, and Norway. The order of the Elder Futharc, a runic alphabet which is markedly different than the order of most alphabets found in the territories of the Roman Empire, allowed for a particularly creative substitution cipher.

The Anglo-Saxon monk Bede describes a substitution cipher in his *Reckoning of Time*. Bede first explains how to use one's hands to sign for numbers, then Bede writes,

> By this means one can, by forming one letter at a time, transmit the words contained by those letters to another person who knows this procedure, so that he can read and understand them even at a distance. Thus one might either signify necessary information by secret intimation, or else fool the uninitiated as if by magic.[1]

Bede wrote in northern Britain during the late seventh and early eighth centuries. Isidore of Seville, born a century earlier than Bede, described

similar ciphers in his widely popular *Etymologies*, the first encyclopedia.[2] Writing was native to Britain long before Bede. The writing systems of Britain included the Irish Ogham (which is comprised of lines intersecting a horizontal plane), northern European Rune scripts, Pictish, and Latin. Anglo-Saxons also knew of Greek and Hebrew alphabets. All were phonetic alphabets—that is, they substituted symbols for sounds, unlike, for example, Chinese. Anglo-Saxon England was a multi-lingual community. Inhabitants were therefore continually presented with concrete evidence that signs are distinguished from their meanings and that a single meaning can be expressed through multiple signs.

Bede's numerical finger-cipher is only one way that monks and nuns transmitted information. They also used their hands to signal meal time, prayer, objects, and so forth. As with Roman actors, hand signals were used by Anglo-Saxons to convey extra-linguistic information. Puzzlement was indicated by pretending to grab one's own beard or to point two fingers at the forehead.[3] An American today might shrug. Such gestures are not ciphers, but a kind of code. Today, a cipher is distinguished from a code, and deciphering from decoding. A code depends upon the substitution of a word or phrase or gesture for a prearranged plaintext. For example, at 7:53 am on December 7, 1941, Commander Fuchida of the imperial Japanese fleet sent the code "Tora! Tora! Tora!" 'Tiger! Tiger! Tiger!' to Admiral Nagumo aboard the carrier Akagi; this word was a prearranged code indicating that the attack on Pearl Harbor was a complete surprise.[4] A distinction between codes and ciphers has been important to cryptographers at least since the sixteenth century, but in earlier Anglo-Saxon England both codes and ciphers were undifferentiated categories of secret or privileged communication.

As well as simple substitution ciphers, Anglo-Saxons used runes to conceal messages, names, and words. One of the more common runic ciphers might better be classed as steganography. A case can also be made for calling it a transposition cipher or even a polyalphabetic substitution cipher. It works by substituting a rune for its rune-name in a text. For example, ᚠ is the first Anglo-Saxon rune and has the sound of /f/. Its name is *feoh* 'cattle, money'. One might substitute ᚠ for the word *feoh* in a poem. By substituting a number of runes in a scrambled order, one can hide a word. The poet Cynewulf signed some of his poems this way. He substituted English runes (for words like "joy," or "ox," or "water") for words in his poems. An audience listening to Cynewulf's poem would likely not recognize the cipher. But a reader would see the runes plainly in a manuscript. A reader could unscramble the written runes and spell out Cynewulf's name. Using runes in this way allowed an author to hide not only his name, but also answers to riddles.

A collection of Old English poetry known as the Exeter Book includes riddles. (Some of them reappear in the mouths of Gollum and Bilbo Baggins in *The Hobbit*.) In some of the riddles, the answer is hidden in

runes within the riddle itself. *Riddle 24*, for example, hides the runes *gyfu* 'gift', *æsc* 'ash', *rad* 'riding, *os* 'mouth', *hægl* 'hail', and *is* 'ice'. Unscrambled, the runes spell the answer, *higoræ* 'magpie or jay'.[5] The riddle reads, "ᚷ· mec nemnað / swylce ·ᚨ· ond ·ᚱ· ᚹ· fullesteð / ·ᚾ· ond·ᛁ· Nu ic hatan eom / swa þa siex stafas sweotule becnaþ" ("A **gift** they call me, also an **ash** [tree] and **riding**, a **god** (or mouth) supports me / **hail** and **ice**. Now I am to be called what the six letters clearly betoken").[6] A reader of this unique manuscript would have seen the runes, although it is possible that a listener may have recognized them either by the phrase "siex stafas" 'six letters' or by the syntactic and semantic challenges the words pose.[7] Hiding an answer in plain sight, but not in plain hearing, suggests a distinction between the written riddle and its orally-performed counterpart. Scholars like Patrick W. Conner have long thought that the Exeter Book was read out at gatherings. Like *Jeopardy*'s Alex Trebek, the reader would see the answer on the page while gathered listeners worked out the riddle. Clever listeners might hear the hidden answer, as well.

In other riddles, the names of runes were written out in Roman script.[8] As I describe below, that strategy raises the possibility that runic messages might be hidden plainly in Old English poems. For now, we can wonder whether the substitution cipher offered in *Riddle 24* would have been easily recognized by Anglo-Saxons. A cursory reading of the corpus of Old English poetry suggests that the phrase "hail and ice" is unusual. Similar is the phrase "hail and ash" found in Exeter *Riddle 64*. Referring to conventions of runic ciphers, Robert DiNapoli explains that understanding *Riddle 64* requires "an extreme form of 'code breaking'." The runes representing *hail* and *ash* in *Riddle 64* are the first letters of the word *hafoc* 'hawk'.[9] But how would a reader know? Unlike the simple substitution of *Riddle 24* described above, the formula in *Riddle 64* signals a clipping. A clipping is what remains after the end of a word is clipped off. Apparently, readers and listeners alike would know that the relevant formula is RUNE + *ond* 'and' + RUNE = RUNE RUNE …. So, the formula "H and A" tells a reader that "ha" are the first two letters of a word. If DiNapoli is right about *Riddle 64*, might *Riddle 24* also employ a clipping? The two sets of runes in *Riddle 24*, *AR* and *HI*, might then stand for two words. Perhaps *AR* is meant to be read straightforwardly as "ar" 'messenger', which is sometimes symbolized by wings or birds; and perhaps *HI* stands for "higorae" 'jay or magpie'. We might also note that "messenger jay" invokes a false etymology that portrayed the jay as a "higher messenger" (*hig* 'high' *–or* 'er'). Similarly identifying the jay with a higher or transcendent order of being, Isidore of Seville said that *picus* (which is translated in OE as *higore*) "has a certain supernatural quality."[10]

Besides its obvious challenge, *Riddle 64* offers an intriguing possibility. Where Cynewulf placed a rune into a poem, the Exeter Book

riddler sometimes wrote out the *name* of a rune and expected readers to translate it into a rune. *Hail* in *Riddle 24* became ᚻ ("H") in the reader's imagination, and that rune was then used as a portion of plaintext. What if other authors had used this method, writing out the names of runes in hopes that readers would translate them into runes and then into words? To discover whether the corpus of Old English poetry concealed runic messages, I searched for every rune-name. Each poem in the Anglo-Saxon poetic records was scanned and checked for the names of runes, and all the rune-names in each poem of the Anglo-Saxon Poetic Records were collected and translated into runes. I also included rune-names embedded in longer words. Readers are invited to make sense of the results.[11] However exciting the possibilities are for discovering names of authors or scribes, the problems one faces in looking for runic ciphers are many. The rub is that we cannot know whether readers were always alert to possible runic messages or only so while reading riddles.[12]

The most obvious problem in this effort was determining what might be a significant rune-name and what was not. For example, the rune for the sound /i/ is called *is* 'ice', and is a homophone for the verbal copula *is*. Should every instance of *is* be counted as a rune-name, and which of those are significant? Moreover, if *is* appears as part of a compound or in the midst of another word, should it count as a rune-name? The rune *ur* (*yr*) is a fairly common syllable in the middle of words. Should it always count as a rune-name? The rune *thorn* is a good example. It is used very often as an abbreviation for the pronoun *þæt* 'that'. Scribes cross the upper ascender of a *thorn* to indicate that it is to be treated as an abbreviation. This abbreviation appears frequently in the manuscript of *Beowulf*. Another problem is exemplified in a charm against the theft of cattle. The word *feoh* 'cattle' is used three times; it is also the name of a rune. Are rune-names used *as rune-names* to be counted? Further, if an author substitutes a rune for a rune-name, is that a possible signal of a hidden message? The substitution of rune-names for runes is not uncommon, as we have seen in Exeter's *Riddle 24*. One crux in *Beowulf* at line 457 was thought by a critic to have been the result of a rune-name substitution.[13]

Other runic substitutions raise different issues. At the point in *Beowulf* when King Hroðgar's man Unferth addresses Beowulf, the scribe of the manuscript at folio 143v, line 18, writes the rune *ethel* for the word meaning 'home, homeland' (line 520b). He places it between two dots.[14] He does the same thing at the end of the Sigemund episode at line 913a. He does it once more during the speech Hroðgar makes describing the ancient sword hilt brought back from Grendel's mere, inscribed with *runstafas* 'rune letters, secret letters' (line 1702a). The scribe or scribes of the last portion of the poem do nothing like it in the text, although they place fitt-numbers between dots. One wonders why the scribe did it. He was not saving space. Except for in the riddles, the occasional use of

runes and rune-names in Anglo-Saxon poems is so far largely inexplicable. Perhaps in a multi-lingual society like Anglo-Saxon England, runes were a way of masking or calling attention to certain portions of text.[15] Just as runes were substituted for words, so too were Greek letters substituted for Latin ones from the Carolingian age onward.[16] One finds Greek alphabets written out in almost all Anglo-Saxon manuscripts. One such alphabet can be found in a ninth-century codex containing the letters of St. Boniface, the Anglo-Saxon apostle to the Germans. It correlates the Greek alphabet with other alphabets.[17] Why such a correlation should have been of interest to readers is obviously a matter of speculation, but it does point to an abiding interest in the multiplicity and variety of alphabets, an interest that seems natural to interpreters of the Bible, which was written in Hebrew, Greek, Latin, Gothic, and Old English, among others.

Nevertheless, there does seem to have been a wider sense that runes were appropriate for hiding messages. Other runic substitutions include Isruna and Hahalruna, as illustrated on the runic Rök Stone in Sweden.[18] The substitution resembles the Polybius square invented by an Ancient Greek and used into the present day. A runic alphabet was divided into three groups of eight runes, and the position of each rune in a matrix was indicated by carved horizontal or vertical lines. For example, one short line and three long lines indicate the first group, third rune of such a matrix, which was *thorn*.[19] One might also indicate the same group with capital and small letters, e.g. *I.iii*, as explained in a number of manuscripts from the ninth to eleventh centuries.[20] Another manner of recording these groups was on the Lagu-rune itself. The rune looked like a capital "I" with a top stroke sloped down to one side. Strokes on the upper end of the shaft indicated row, and strokes on the lower end of the shaft indicated column. These stroked Lagu-runes might be concealed in drawings. They could be tilted and superimposed over one another so that they look like *x*'s, keys, fish, men, snakes, or stalks of wheat. A Bergen rune stone uses all these pictorial forms, and one can see a fish with two fins on its belly and four fins on its back, indicating a group 2–4. This particular form of encryption is called *fiskrúnar* 'fish-runes'.[21]

Groups were also indicated by pointings, or dots. On a bone found in Schleswig one finds dots arranged to indicate runes—dots were sometimes used in manuscripts as substitutes for vowels.[22] An interesting and possible use of the cryptographic rune group derives from one of the earliest surviving Icelandic manuscripts on magic and is called *galdramyndir*. Stephen Flowers proposes that the runic alphabet be written into a four-by-four square. The name of a god is then traced from rune to rune, leaving a geometric pattern. Once that geometric pattern is removed from the rune-inscribed square, it becomes meaningless to the uninitiated. But once placed atop a square, the meaning reveals itself.[23] Similar Icelandic magical traditions survived into the early modern period, and

they can be glimpsed in legal cases against magicians dating from 1554 as well as in roughly two dozen manuscripts.[24] One cannot be sure what was meant by *magic*, of course, but perhaps it implied that which is hidden or concealed.[25] Bede seems to suggest as much in his description of the finger cipher above. In short, runic encryption took place not only on the manuscript page, but also in margins, on stones, carved into bones and clasps, and concealed in drawings.

Other sorts of runic crypts include transpositions (in which runes are transposed backwards or forwards), clippings, and so forth. An example of a runic transposition is found on the Nydam shaft: *lua* for *alu* 'ale'. We are reminded here of Cynewulf's name, which was transposed in the extant manuscripts, as were answers to some riddles. Another, longer transposition on a stone in Rimsø reverses four words so that [*muþur is t*]*auþi:sam:uarst:maki* 'Mother's death is the worst thing that could happen' becomes *ikam:tsrau:mas:iþua*. When searching in Anglo-Saxon manuscripts for rune ciphers, the possibility of a reversal should be kept in mind. So should the possibility of a clipping. A clipping is demonstrated on a Stentoften stone: *f* for *fahi* 'paint, write'. We have seen similar clippings already in the Exeter *Riddles*. Vowels were sometimes dropped: *rnr* from *runor* 'rune' is found on a clasp from Etelhelm. To complicate matters further, Klaus Düwel notes that from the eighth century onward, runes were used to conceal Roman letters. As well as masking information, runes were used in prognostics, in medical texts, and as mantic alphabets.[26]

As well as demonstrating an interest in runic ciphers, literate Anglo-Saxons seem to have been fascinated by a simple monoalphabetic substitution cipher known as a Caesar alphabet, Caesar cipher, or Caesar shift. We have seen that Isidore brought the formula for the Caesar shift into the Middle Ages from his reading of the classics. St. John's College, Oxford MS 17, a twelfth-century copy of earlier material, contains one.[27] On folio 6 recto of that manuscript, a seventeenth-century reader seems to have enjoyed solving the Caesar shift. It is not a particular difficult cipher by modern standards. The first letter of the plaintext alphabet is replaced in the ciphertext by the second letter, the second by the third, and so forth. *A* becomes *b*, *B* becomes *c*, etc. Rather than shifting by one letter, one could also shift plaintexts by three letters, four, and so forth. More complex Caesar shifts involve shifting the first letter of the plaintext by one letter, the second letter by two, the third by three, and so on, according to a prearranged pattern—a shift that was used in military ciphers even into the modern age. The German naval Enigma was an extremely complex Caesar shift, in which each letter of plaintext was shifted according to a predetermined pattern—the first shift was hard-wired into a disc, one of five in a connected series that was rearranged daily and then convoluted with a sixth soft-wired shift that was itself changed daily.

There were, of course, other substitution ciphers. St. Boniface, Anglo-Saxon missionary to the Germans in the eighth century, used substitution ciphers to conceal proper names in his letters. A similar Bonifatian cipher shows up in the Exeter Book's *Riddle 36* to muddle Latin words. We find substitution ciphers in an eleventh-century *liber vitae* of Hyde Abbey, in a letter to Archbishop Dunstan, in scribal notes, and elsewhere. None are particularly complex. One is forced to wonder, therefore, whether ciphers appealed to Anglo-Saxons for their obvious practical benefit: security. A need for security arises in part from a need to send written messages over long distances. Anglo-Saxon courts, like most others, employed messengers, which may have significantly lessened the need for secure, written messages. It may also be the case that strategies for decryption were so primitive that even a simple cipher would conceal information sufficiently well.

Not all ciphers were primitive. A keyword cipher was used throughout Europe to protect and authenticate correspondence. The Council of Nicea in 325 recommended that ecclesiastical correspondence be protected by a keyword added to the text. The enciphering process was described in detail by Notker the Stammerer, a monk of St. Gall in the ninth century. According to Notker, Latin names were to be transliterated into Greek, whose letters had numerical value. The value 481 was used as an initial sum, since it represented the first letters of the Greek names of *Father*, *Son*, and *Holy Spirit*—the *pi* of *pater* is worth 80, *gamma* and *alpha* 400 and 1, respectively. To this sum is added "the first letter of the writer of the *epistola*; the second letter of the addressee; the third letter of the bearer; the fourth of the city in which it was written; and the number of the current [Papal] indiction."[28] Added to these was the number 99, representing the Greek "Amen." The cipher proved too complicated for general use. But it was certainly known to literate readers, and on something like it depends a passage of Prudentius' *Psychomachia*. In his preface to this poem, Prudentius writes "that we are abundantly rich in servants born in the house if we know through the mystic symbol what is the power of three hundred with eighteen more."[29] 318 rendered in Greek letters is TIH (tao, ipsilon, eta): TIH is "a symbol of Christ crucified, T representing the cross, while IH are the first two letters of the [Greek spelling of the] name Jesus."[30] Note that this two-letter clipping resembles the runic clipping of *Riddle 24*. Bede describes the numerical value of Greek letters in his *Reckoning of Time*, as does Hraban Maur (Hrabanus or Rabanus Maurus) in his "De inventione linguarum."[31] In the same treatise, Maur describes how to substitute dots for vowels. For example, a single dot represents "i" in "·nc·p·t" and other arrangements of dots represent other vowels.[32] The similarity of using dots as vowels intriguingly recalls Masoritic Hebrew, which appeared in Western Europe during the late Anglo-Saxon period.

Another practical use of ciphers is to conceal information from the uninitiated. Hraban Maur may have adopted his substitution cipher

from one of the more important Christian missionaries of Anglo-Saxon England to the Continent, Boniface.[33] Boniface did not invent the code, but he adapted a code known to us through the work of Tacitus. Like Maur, he substituted dots for vowels, so that one dot represented "i," two dots superimposed represented "a," and so forth. Again, "Incipit versus Bonifacii" begins " ·nc·p·t." Boniface may have learned this cipher in turn from the works of Alcuin, a native of York in northern Britain but chief scholar in the court of Charlemagne. Alcuin had a similar substitution cipher. In the twenty-sixth chapter of his *Propositiones ad acuendos iuvenes*, Alcuin illustrates a cipher where *b* = *a*, *k* = *i*, *f* = *e*, and two dots represent *o*. He writes, "Propositio de cursu cbnks bc fvgb lfp:rks," the last portion of which deciphers to *canis ac fuga leporis* 'running dog or fleeing hare'.[34] Maur's version is found in a number of eleventh-century manuscripts, including British Museum Add. MS 21917, from Luxeuil in the eleventh century. There, a scribe names himself in a substitution cipher: "Hbfc Stfphbnxs scrkpskt …"[35] Stephen is not the only scribe who wants his name remembered and perhaps uttered by those clever enough to find it. One of the more famous revelations of a scribe's name comes in a manuscript of the *Life of Saint Boniface* from around the year 800 that includes the lives of two of Boniface's relatives. The cipher appears between two lives. In a variant of the Maur substitution cipher, the vowels are replaced by abbreviations for the vowels, so that *primus* (abbreviated "pri") substitutes for *a*, *secundus* (abbreviated "secd") for *e*, and so forth. The plaintext of this cipher reads, "Ego una Saxonica nomine Hugeburc ordinando hec scribebam" ("I, an ordained Saxon woman named Hygeburg, wrote this"). While most of this phrase is conventional and formulaic, Hygeburg makes a nice pun on *ordino*, given that she uses *ordinal* numbers to substitute for vowels.[36]

One can imagine a number of reasons to conceal one's name—modesty, convention, play. But more than firing our imaginations, concealment raises intriguing issues of the cultural uses of secrecy. In her book *Covert Operations*, Karma Lochrie wrote,

> If today the private has come to designate crucial spaces of personal subjectivity and property that are secured from publicity but are not necessarily secret, in the Middle Ages the association of the secret with divine mystery and Christian subjectivity … rendered medieval privacy something more covert and charged than its modern version is.[37]

The realm of the secret, as Lochrie describes it, protects and mystifies, among other things. The example of Hygeburg offers an illustration of how the secret is a disguised signifier from which can emerge the voice of a man or a woman—of Stephen or Hygeburg. The secret can be conceived of not as a dark and hidden sphere denuded of the moral light of public examination, but as a higher plane to which a reader must ascend.

An interest in secrecy and ciphers also corresponded to a larger interest in the complexity of revealed creation. Bede had noticed the hidden patterns of the tides in northern England and was an internationally recognized expert in the hidden patterns of time underlying the seasons. Bede's interest was in keeping with a larger Christian belief in the mathematical order of creation, an aspect of the *Lôgos*, a Greek word that was used to name Christ (in John 1:1), and which also means 'logic' and 'language'. Language was considered an orderly natural phenomenon, like the disposition of the stars or the manifold variety of animals. Language was not arbitrary. Consequently, words and pieces of words were subject to mathematical order just as were all natural phenomena.

The Ptolomeic, neo-Platonic universe of concentric spheres which medieval and Renaissance writers inhabited was literally a sphere of seriated moral spaces. The moral space of secrecy is not earth-bound, but a higher sphere located above the multiplicity of earthly life and closer to the divine unity. The "divine mystery" which pertains to secrecy comprises a kind of knowledge, an inspired ability to read and to understand the fallen languages of man. To write in code and cipher, to maintain one's anonymity as a scribe, is, in part, to participate in the divine, heightened mystery of language. We should note therefore that Hygeburg does not reveal her name in language, but in cipher. Her identity is technically still secret, since it has not fallen from the sphere of secrecy into the sublunar realm of human language. The poet's art is associated with that rarified sphere, as Oswald of Ramsey attests in the first decade of the eleventh century. We read him in the Cambridge Songs manuscript, Cambridge University Library Gg. 5.35, of the eleventh century from St. Augustine's, Canterbury: "If [God] deign to touch my mind with the Holy Ghost, I shall straightaway be called wise [*prudens*] in the true sense of the word; henceforth I'll also be able to associate with learned men."[38] Here, Oswald puns on *pneumatos*, a Graecism meaning breath or spirit, which plays with the Latin sense of *inspir*ation. The connection between Greek and Latin senses of spirit, breath, and soul was widely known in the early Middle Ages. His wisdom is *prudens*, which is both the skill and judiciousness necessary to a poet's art. Judiciousness is indeed necessary since, as Winthrop Wetherbee has noted, in the neo-Platonic system, "Poetry was in the service of wisdom."[39]

It seems to me that the neo-Platonic universe described by Macrobius in his commentary on the dream of Scipio, or by Boethius in his *Consolatio Philosophiae*, would have to have made a place for ciphers and secrecy. Familiar to many medievalists are Carolingian grid poems. They seem, at first glance, only an interesting game. Some of these poems can be found in the Cambridge Songs manuscript.[40] Folio 212v offers a poem by Hraban Maur in which the names of various orders of angels are hidden. Folio 222r offers his poem on the name of Christ. Alcuin wrote a similarly constructed acrostic on the Holy Cross. Similar to the

riddles of the Exeter Book, when the poem is read aloud, the names of the angels become hidden or enciphered. But when the poem is read on vellum, the names of the angels are quite obvious. In their manuscript contexts, these poems are not ciphers. Instead, the poems illustrate how divine names and religious messages can permeate a well-made song. These messages are intercalated into poetic discourse. In the medieval universe of concentric spheres, the well-wrought music of language, its carefully crafted number (that is, its meter), and its intellectual content all coalesce in the higher spheres of intellect and soul. Christian poetry, as an intellectual and spiritual and mathematical exercise, thus transports a reader beyond the terrestrial realm to participate in the increasing unity of intellect, soul, and number. The messages in the poems are secret not because they are hidden but because they both transcend and inform the baser language of secular, practical life.

Secrecy is also used for reasons evident in the phrase "pearls before swine." Ciphers were used to keep divine secrets hidden from baser readers. We have already seen the cipher 318, and I should note that Prudentius' *Psychomachia* from which this cipher is taken is also found in the Cambridge Songs manuscript. There is a famous cipher in the book of the Apocalypse. Revelation 13:18 reads, "Let him that hath understanding count the number of the beast: for it is the number of a man; and his number is Six hundred threescore and six." We know that John's primary purpose is not to allude to 2 Chronicles 9:13, ("Now the weight of gold that came to Solomon in one year was six hundred and threescore and six talents of gold") because John alerts us to the "number of the Beast" and calls it "the number of a man." In fact, this number is an example of a Hebrew cipher, like the Greek cipher for 318, in which alphabetic characters are given their numeric values, then added up. The name of the persecutor of the Christians in Hebrew during the time of John is Caesar Nero [Hebrew: *neru kayser*]. *Resh* has as its numerical equivalent 200, *Samech* is 60, *Koph* is 100, *Nun* is 50, *Vav* is 6. *Resh* and *samech* together give 260, add *koph* for 360, add *nun* for 410, add *vav* for 416, add *resh* for 616, and add *nun* for a total of 666. That is the number of the Beast, Nero. The Apocalypse is in part a coded and enciphered commentary on Roman persecution of Christians. Another Hebrew code used in the Bible is called *Atbash*, after the cipher keys *Aleph*, *Tav*, *Beit*, and *Shin*. The first letter of the alphabet, *Aleph*, is substituted by the last letter, *Tav*. The second letter, *Beit*, is substituted by the penultimate letter *Shin*, and so forth. Thus in Jeremiah 25:26, we read the nonsense word "Sheshach." Deciphering this word using *Atbash* gives us the plaintext "Babel." Saint Jerome explained the Atbash code to the Middle Ages in the early fifth century.[41]

Since both Greek and Hebrew alphabets are used for counting as well as spelling, savvy readers of the Hebrew Old Testament and the Greek New Testament were acclimated to the "idea of letter substitutions."[42]

Furthermore, the fact that in Hebrew and Greek the order of numbers (1, 2, 3, 4, 5, …) corresponds to the order of letters (aleph, beit, gimmel, alpha, beta, delta, etc.) meant that the alphabet was more than an arbitrary list. Each letter was the site of phonological and numerical value. Allusions might be based not only on root letters but also on numerical equivalents. The Talmud notes that when God spoke to Moses, saying, "You shall be for me a kingdom of priests" (Ex 19:6), He used the Hebrew word *li*, "which," as Rabbi Michael Munk explains, "has a numerical value of forty, [thus] God indicated to Moses that their promise would not be kept for more than forty days, for after the forty days they built the Golden Calf."[43] Rabbi Munk notes that the initial *Mem* of the name Moses, which has the value of forty, reminds us that Moses "immerse[d] himself in Torah for forty days" after ascending Mount Sinai. The Talmud teaches that no man achieves wisdom "until after forty years."[44] Again, substitution ciphers are a preliminary to an allegorical or tropological reading.

In his commentary on Genesis, Jerome makes similar note of the value of letters. Of Genesis 17:15, Jerome writes, "Those people are mistaken who think that the name Sarah was written first with one R and that another R was afterwards added to it; and because among the Greeks R represents the number 100, they surmise many absurd things about her name."[45] Absurd or not, by his critique Jerome alerts us to the importance to readers of substitution ciphers in inferring the deeper mysteries and secrets of Scripture. Early Medieval English readers demonstrate, as in the Cambridge Songs manuscript, their interest in this higher significance of letters, runes, and alphabets. Although we are not much beyond listing Anglo-Saxon ciphers and noting an interest in ciphers, my hope is that we can contextualize that interest. With sufficient empathy, we can view Anglo-Saxon ciphers not as childish attempts at our own, but, as E.J. Christie does in this volume, as acknowledging the role of language as a means to secrete oneself in a transcendent order.

Notes

1 Bede, *The Reckoning of Time*, trans. Faith Wallace (Liverpool: Liverpool University Press, 1999), 11.
2 Isidore of Seville, *The Etymologies*, trans. Stephen A Barney *et al.* (Cambridge: Cambridge University Press, 2006), I.26, 52. In I.25, Isidore describes the Caesar cipher.
3 Charles R. Dodwell, *Anglo-Saxon Gestures and the Roman Stage* (Cambridge: Cambridge University Press, 2000), 102.
4 David Khan, *The Codebreakers: The Story of Secret Writing* (London: Weidenfeld and Nicolson, 1967), 62.
5 On Old English runes, see Raymond I. Page, *An Introduction to English Runes* (Woodbridge: Boydell, 1999) and on their use in poetry, Robert Di Napoli, "Odd Characters: Runes in Old English Poetry," in *Verbal Encounters*, eds. Antonia Harbus and Russell Poole (Toronto, ON: University of Toronto

Press, 2005), 145–161. The rune *os* is sometimes translated as 'mouth', supposing a confusion of the Latin ōs with the Old English. Old English *os* is cognate with the Old Norse *áss* 'pagan god', the plural of which is *Æsir*, the name of the family of gods whom Odin rules. It is a common name element in Anglo-Saxon England (as in Osbert). My thanks to Michael Moynihan for his discussion of *os* in his recent dissertation. Odin (Old English Ẅoden) was the source of poetry. See also Joseph Bosworth and J. Northcote Toller, *An Anglo-Saxon Dictionary* (Oxford: Oxford University Press, 1908), 768. DiNapoli, "Odd Characters," argues that the poet intended 'mouth' but also to imply the older meaning of 'a god,' 149–150.

6 Riddle 24, in George Philip Krapp and Elliot Van Kirk Dobbie, *The Exeter Book* (New York: Columbia University Press, 1936), 193.

7 The point is made by DiNapoli, "Odd Characters," 156. Symons disagrees: *Runes and Roman Letters in Anglo-Saxon Manuscripts* (Berlin: De Gruyter, 2016), 35.

8 See Dieter Bitterli, *Say What I Am Called: The Old English Riddles of the Exeter Book & the Anglo-Latin Riddle Tradition* (Toronto, ON: University of Toronto, 2009), 83–113.

9 DiNapoli, "Odd Characters," 153. See also John McKinnell, Rudolf Simek, and Klaus Düwel, *Runes, Magic and Religion: A Sourcebook* (Vienna: Fassbaender, 2004), 26.

10 Isidore, *Etymologies*, 267.

11 The results can be found at www.bede.net/misc/runes.html.

12 Victoria Symons suggests that "pre-existing knowledge of established techniques" was unlikely to have been part of the convention of reading riddles. See *Runes and Roman Letters*, 34.

13 H. Matthes, "Kampfrune und Buchschriebersymbole," in *Monumentum Bambergense*, ed. H. Nottarp (Munich, 1955), 367–377; cited by Robert D. Fulk *et al.*, *Klaeber's Beowulf*, 4th ed. (Toronto, ON: Toronto University Press, 2008), 145.

14 Damien Fleming has suggested that the name of the scribe might be Ethelweard; see his "*Eþelweard*: The First Scribe of the *Beowulf* MS," *Neophilologische Mitteilungen* 105 (2004): 177–186.

15 Symons suggests that the elevated dots help the reader to interpret the runes and distinguish the runes from the rest of the text. See her *Runes and Roman Letters,* 22.

16 Bernhard Bischoff, "Übersicht über die nichtdiplomatischen Geheimschriften des Mittelalters," *Mitteilungen des Instituts für Öseterreichische Geschichtsforschung* 62 (1954): 1–27, 6–7.

17 Bischoff, "Übersicht," 11.

18 Khan, *Codebreakers*, 88.

19 Klaus Düwel, *Runenkunde*, 3rd ed. (Stuttgart: J. B. Metzler, 2001), 183. See more generally his Chapter 10. The examples that follow are from Düwel, 182–188.

20 Düwel, *Runenkunde*, 184.

21 Ibid., 187.

22 Bischoff, "Übersicht," 16.

23 Stephen Flowers, *Icelandic Magic: Practical Secrets of the Northern Grimoires* (Rochester, VT: Inner Traditions, 2016), 77–80.

24 Magnús Rafnsson, *Rún: galdrabók* (Hólmavik: Museum of Icelandic Sorcery and Witchcraft, 2014), 131.

25 See Stephen Flowers, *Studia Germanica* (Smithville, TX: Rûna-Raven, 2000), 1–4; and Chapter 4.

26 Düwel, *Runenkunde*, 83. Like the *fiskrúnar* is Ogam (or Ogham), the Irish writing system dating from the fifth century. The alphabet was divided into three groups of five consonants and one group of five vowels. The consonants were indicated by lines to the right, to the left, or intersecting a long line, and vowels by dots on the long line. In one Ogam cipher, an alphabetic group was indicated by a vertical stroke above a horizontal line, and the letter number of the group by strokes below the horizontal line.
27 Page, *Runes*, 62. Jerome described this earlier to the Middle Ages; see Bernhard Bischoff, "Übersicht," 5.
28 C. H. Talbot, trans., "Willibald: The Life of Saint Boniface," in *Soldiers of Christ*, eds. Thomas F. X. Noble and Thomas Head (University Park, PA: Pennsylvania State University Press, 1995), 121, n. 28; taken from Bernice M. Kaczynski, *Greek in the Carolingian Age: The St Gall Manuscripts* (Cambridge, MA: Medieval Academy, 1988), 34. My thanks to Celia Chazelle for this reference. Ciphers were not the only way to protect correspondence: certain cola, or patterns of metrical feet ending a line, served to authenticate Latin letters; and Merovingian cursive script was developed in part to foil counterfeiters.
29 "nos esse large vernularum divites / si quid tricenti bis novenis additis / possint figura noverimus mystica," *Praefatio*, lines 56–58; ed. and trans Henry J. Thomson, Loeb (Cambridge: Harvard University Press, 1949), 278.
30 Thomson, *Prudentius*, 279, n. a. "Servants in the house" refers to Leviticus 22:11 and similar injunctions that a servant born in a Jewish house must be circumcised.
31 Bede, *Reckoning*, 11; Hrabanus Maurus, "De inventione linguarum," *Patrologia Latina* 112: 1579–1580.
32 Maur, "De inventione," *Patrologia Latina* 112: 1581–1582.
33 The kinds of substitution ciphers are listed and described by Bischoff, "Übersicht." The reader will notice that I am deeply indebted to that article.
34 Wilhelm Levison, "Appendix VIII: St Boniface and Cryptography," *England and the Continent in the Eighth Century* (Oxford: Clarendon, 1946), 290–294, at 293. Alcuin's code may have been influenced by Ogham; see Bischoff, "Geheimschriften," 16, §134c.
35 Levison, "Appendix VIII," 293.
36 Text and solution in Levison, "Appendix VIII," 294.
37 Karma Lochrie, *Covert Operations: The Medieval Uses of Secrecy* (Philadelphia: University of Pennsylvania Press, 1999), 136.
38 Trans. Michael Lapidge, "The hermeneutic style in tenth-century Anglo-Latin literature," *Anglo-Saxon England* 4 (1975): 67–111, at 107. See Jan M. Ziolkowski, ed. and trans., *The Cambridge Songs* (Carmina Cantabrigiensia) (Tempe, AZ: Medieval & Renaissance Texts & Studies, 1998), xxvi–xxx.
39 Winthrop Wetherbee, *Platonism and Poetry in the Twelfth Century: The Literary Influence of the School of Chartres* (Princeton, NJ: Princeton University Press, 1972), 16.
40 See Ziolkowski, *Cambridge Songs,* xxvi–xxx.
41 See Bischoff, "Geheimschriften," 5, §15.
42 Khan, *Code Breakers*, 9.
43 Michael Munk, *The Wisdom in the Hebrew Alphabet* (Brooklyn, NY: Mesorah, 1983), 149.
44 *Avodah Zarah* 5b. In Munk, *Hebrew Alphabet*, 148.
45 *Saint Jerome's Hebrew Questions on Genesis*, trans. C.T.R. Hayward (Oxford: Clarendon, 1995), 49.

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4 The Cryptographic Imagination

Revealing and Concealing in Anglo-Saxon Literature

E.J. Christie

In his cryptographic treatise *Mercury, the Secret and Swift Messenger* (1641), John Wilkins imagines secret writing as a natural outgrowth of the human need for self-realization. Our happiness is "imperfect and dependent," he writes, but we may nevertheless through language arrive at well-being by contracting and communing with others. He inserts cryptography into the Renaissance paradigm of natural language development: the angels have no need of language, since as spiritual beings they "hear, know, and speak with their own substance."[1] As material beings, humans need "corporeal instruments" to mediate their communion.[2] The tongue and the ear are the vehicles of speech. Because spoken words only communicate with those present, however, letters were invented such that communication develops as a series of nested mediations: writing represents speech as speech represents thoughts. Thus, "we may discourse with them that are remote from us, not only by the distance of many miles, but also of many ages."[3] Some exigencies require communication still more swift and more secret, Wilkins reasons, and it is thus that since the ancients some have labored to find forms of communication that correct these deficiencies. Though these studies are useful for "special occasions," the subject nevertheless belongs "unto one of the Liberal Arts."[4] Rather than simply a correlational code, a means of disguising everyday communication by substituting a conventional sign with an equivalent sign known only to a few, encryption is part of a wider process of human perception and interpretation: cryptography represents writing, as writing represents speech, as speech represents thought.

Wilkins's situation of cryptography within this wider sphere of expression might be approved by Umberto Eco, who demonstrates that, rudimentary susbstitutions like Morse Code aside, "every true code also correlates an expression to a series of contextual instructions and triggers inferential processes."[5] That is, encryption requires and implies a further set of hermeneutic rules, a "code" in the grander cultural sense. Disguise and display, revealing and concealing, are processes central to human self-fashioning, a venerable tradition in sociology suggests.[6] Like Wilkins, we should recognize that deliberate acts of orthographic

obfuscation are often informed by broader philosophical conceptions of the hidden in human expression and communication, such that the ludic textuality of Anglo-Saxon literature, for example, is not merely a technical fetishism but rather a microcosmic expression of their perception of universal laws.

For Anglo-Saxon literati, "secret writing" was not simply a subset of writing but rather an explicit emblem of the truth about all signs. The authorized mode of reading was exegetical and took for granted the layering of subtextual meanings. Anglo-Saxon literature, densely populated with runic, acrostic, riddling, and other grammatological manifestations, evinces a profoundly cryptographic imagination. Such an imagination, as Shawn Rosenheim describes it, is demonstrated through "a constellation of literary techniques concerning secrecy in writing."[7] Thus the category includes not only stories directly involving codes or ciphers but also those that employ "acrostics, allusion, hidden signatures, chiasmal framing, [and] etymological reference" as well as the "thematic consequences of such techniques" such as "anonymity, doubling, identification and the like."[8]

Contextualizing and authorizing the ludic textuality of Anglo-Saxon manuscripts was the theological conception of the natural world as a cipher for a hidden divine reality and the concomitant grammatical identification of individual letters as material conduits of meaning.[9]

The Anglo-Saxons were not unique in their perception of the physical universe as an opaque testament to God's invisible architecture. As James Bono's work on Renaissance language theory stresses, the intersecting discourses of language, science, and religion resulted in a reformulation rather than a rejection of medieval questions about "humankind's access to divine secrets implanted in nature."[10] Martin Elsky argues, furthermore, that in the conflux of Early Modern language theories, "the written marks of language take on an ontological status of their own."[11] That is to say, individual letters could be seen anew as discrete, material objects whose own relation to the information they transmitted was far from transparent. I suggest, however, that the ontological status of letters was an active question in Anglo-Saxon textual culture, displayed in literary toying with their cryptographic potential.

The hidden/shown relation so literal in cryptography has a long history in hermeneutic thought. In the Hellenistic allegorical tradition, *hyponoia* came to designate the covert meaning or "undermeaning" of a text, that is, its deeper and truer sense.[12] In formulating a Christian exegesis, Clement of Alexandria (d. 215) proposes *hyposemeiosis*—the interpretation of hidden signs—as a methodological counterpart to the enigmatic meaning so extracted.[13] Clement interprets basic acts of reading, rising from recognition of individual letters, to lexemes, to logos, as themselves allegories of allegorical meaning.[14] Influenced by Christian metaphors and their inherited exegetical method, Anglo-Saxon authors

were predisposed to characterize wisdom as hidden, the texts that contained it as encryptions, and the process of understanding them as a sort of decoding, an uncovering of disguised or buried sense. Anglo-Saxon monk and influential scholar the Venerable Bede (d. 735), in the preface to his commentary on the books of Ezra and Nehemiah, writes that he intends to "peel back the bark of the text" to discover something "deeper and more sacred in the marrow of the spiritual sense."[15]

That is to say that, to Anglo-Saxons, reading entailed a serial process of deciphering. In the early middle ages when many manuscripts were still copied in *scriptio continua*, for example, such simple tasks as finding word boundaries and distinguishing correct letters entailed both skill and work. The marks and glosses of Anglo-Saxon scribes, like their Welsh and Irish counterparts, demonstrates the effort that was sometimes required prior to reading in *recognizing* the "text" within the mass of textuality.[16] The rudimentary task of distinguishing the text played a prominent role in their literary discourse, and it suggested fundamental analogies through which to understand higher orders of interpretation and knowledge.[17] As Christian scripture makes abundantly clear, God is both He whose secrets cannot be known and He from whom no secret can be kept. The entire sacred history of the world is imagined as a narrative of concealing and revealing: the Fall and the resulting alienation from paradise, the confusion of languages, the blindness of man to a divine reality disguised behind the fabric of the firmament, to be undone at "apocalypse" or "revelation"—the rending of the world-text so that humanity is once more exposed without mediation to transcendent reality. The whole of this historical movement is expressed concisely in the alphabetical conceit of Revelation (1:8): "I am Alpha and Omega, the beginning and the end." With these words the alphabet itself becomes a cipher for Christian history. Isidore of Seville (d. 636), whose encyclopedic work was a mainstay of Anglo-Saxon learned culture, thus identifies alpha and omega as "mystical letters" in the typology of letters that opens his chapter on grammar.[18] From the fabric of reality itself, to the microcosm of the discrete graphic sign, Anglo-Saxon hermeneutics places a premium on the relationship of the hidden/shown and their literature is riddled with depictions of simultaneous disguise and display.

The relation of the hidden/shown governs Anglo-Saxons' encounters with each other as with text. Whether their origin is in the folk-traditions of Germanic oral cultures or in literate Latin culture, the texts of the Anglo-Saxon literary tradition dwell persistently at the moment of intercourse, the testing and probing of hidden intentions behind outward signs. Old English Wisdom literature is both *in* dialogue form and *about* dialogue as it reminds us insistently of the needs both to share wisdom and to keep it sequestered: "Ne læt þinne ferð onhælne," says *Maxims I*, "degol þæt þu deopost cunne!" (Do not let your thoughts be hidden, or what you know most deeply remain obscure).[19] Another

poem, *The Wanderer*, suggests the contrary, that thoughts *must* be hidden: it is best for a noble man "þæt he his ferðlocan/ fæste binde, healde his hordcofan,/ hycge swa he wille" (bind his thought-locker fast, keep his mind safe, whatever he thinks).[20] The riddles of the *Exeter Book*, where both of these poems are found, hide the identity of their speakers and encourage us to interrogate them. They stage a discourse in which identity is simultaneously revealed and concealed.

In the three examples that follow, I demonstrate the cryptographic imagination at play in Anglo-Saxon literature. Ælfric of Eynham's *De Temporibus Anni* and related Old English depictions of the firmament confirm its identity as a limit of perception, a screen through which regular modes of signification do not penetrate. It thus suggests a hermeneutic world in which different kinds of sign offer different levels of access to information. The Blickling Homily for Easter Day, however, an anonymous homily from the same era, depicts the rending of that veil and imagines the response of human beings at finally perceiving divine reality as an attempt to "encrypt" themselves: desiring the comforting mediation of the material world, they beg the earth itself to "swallow" them. If these scenes explore the idea of the visible world as a cipher, the final poem depicts a far more literal contemplation of encoded messages. The speaker of *The Husband's Message* appears to be a personified secret letter sent between a separated husband and his wife. Situated in the *Exeter Book* next to a famous riddle collection, and closing with a cryptic runic message, this poem is cryptographic in both form and theme.

"Tell me why heaven is called heaven," says Saturn in the Old English prose dialogue of *Solomon and Saturn*. Solomon replies, "Because it conceals everything that is above it." (*Saga me for hwilcum ðingum heofon sy gehaten heofen/ Ic ðe secge, for þon he behelað eall þæt hym beufan byð*).[21] This concise, gnomic intercourse epitomizes a fundamental point of contemporary cosmology: the firmament, conceived as a material sphere, surrounds the world and separates it from the realities above. The same point is confirmed in further detail in Ælfric of Eynsham's treatise *De Temporibus Anni* (c. 990), where he writes that,

> On ðam oðrum dæge gesceop God heofonan, seo þe is gehaten firmamentum, seo is gesewenlic and lichamlic, ac swa ðeah we ne magon for ðære fyrlenan heahnysse, and þæra wolcna þicnysse, and for ure eagena tyddernysse hi næfre geseon. Seo heofen belicð on hire bosme ealne middaneard, and heo æfre tyrnð onbuton us swyftre ðonne ænig mylenhweowul, ealswa deop under þyssere eorðan swa heo is bufon. Eall heo is sinewealt and ansund, and mid steorrum amett. Soðlice ða oðre heofenan ðe bufon hire sind, and beneoðan, sind ungesewenlice, and mannum unasmeagendlice. Sind swa ðeah ma heofenan, swa swa se witega cwæð; Celi celorum, þæt is heofena heofenan. Eac se apostol Paulus awrat þæt he wæs gelæd oð þa

> ðriddan heofenan, and he ðær gehyrde ða digelan word ðe nan man sprecan ne mot.
>
> On the second day God created heaven, which is called the firmament; it is visible and material, but nevertheless we can never see it because of its great distance, the thickness of the atmosphere, and because of the weakness of our eyes. Heaven encompasses in its bosom the whole earth, and it constantly turns around us more swiftly than any mill-wheel, going as far below the earth as does it above. It is completely circular and entire and adorned with stars. Now the other heavens that are above and below it are invisible and unfathomable to men. There are, however, more heavens; as the prophet said, *celi celorum*, that is, "heavens of heavens." The apostle Paul also wrote that he was led up to the third heaven, and there heard the secret words [*arcana verba* in the Vulgate] which no man may speak.[22]

To be beyond the firmament is to find the "invisible" place of God's secrets: "I am higher than the sky," claims the enigmatic speaker of Aldhelm's *De Creatura*, "and can examine God's secrets" (*altior en caelo rimor secreta Tonantis*).[23] *De Creatura* is the final riddle in a series of one hundred Latin riddles penned by Aldhelm (d. 709), the Abbot of Malmsebury and, later, Bishop of Sherborne. Aldhelm is well-known for his influential promulgation of an opaque, erudite "hermeneutic" style of Latin composition, a style being studied and emulated in tenth-century England centuries after Adhelm's death.[24] The Exeter Book contains three different riddles that bear a relation to Aldhelm's Latin verse, Riddles 40, 66, and 93. The most extensive of the three, Riddle 40 (lines 38–9), includes a vernacular interpretation of the line I quote above, suggesting that Creation, a reality greater than the sum of its parts, is charged with guarding God's secrets: "Hyrre ic eom heofone, hateþ mec heahcyning/ his deagol þing dyre bihealdan," ("I am higher than heaven, the High King commands me to guard carefully his secret things.")[25]. Each reinterprets and refines the purpose of the Latin enigma, but that three versions exist at all suggests the power this vision of creation held for literate Anglo-Saxons.

Where some literature firmly establishes the idea of the material world as a cipher for "hidden" realities, other works dramatize the frightening possibility that divine secrets are suddenly revealed. Old English Homiletic literature imagines apocalypse, the rending of the veil of the material world, as a literal and concrete historical event. The Blickling Homily for Easter Day, for example, describes the moment of final judgment at which men will have access to the transcendent realm, when "all men shall see what it will be at this world's end" (*þonne geseoþ ealle men þæt hit wile beon æt þis worlde ende*).[26] In this anonymously authored homily of the tenth century, ruptures in

the earth and sky mirror each other in a scene that depicts mankind attempting to hide from the unbearable presence of divine being. The scene is structured both by the staple medieval analogy between the firmament and the book and by the imagery of effraction, as the sky tears open and angels look directly on mankind. Reality is thus imagined as *hyponoia*, an undermeaning obscured behind the "book" of the firmament.

On the first day of the apocalypse, "the heavens shall be rolled up like a book" (*Ond on þam dæge heofon biþ befealden swa swa bōc*).[27] On the second, "the heaven shall be open at one quarter—on the east; and that evening a great host shall come forth from the open end and obscure and cover the heavens" (*heofon bi open on sumum ende on þæm eastdæle. One micel mægen forþcymeþ þurh þone openan dǣl, þone heofon oforþecþ ond oforwyrt æt æfen*).[28] These images forge a connection between the rupture between realms and the spillage of divine presence into the material world through the "book" of the heavens. The connection is elaborated further by the upheaval of the third day, when "the earth on the North and East parts will speak to one another, and the abyss growl, and attempt to devour the earth" (*seo eorþe on þam norþende on on þam ēastende sprecaþ him betweonum, on the nēolnessa grymetiaþ, on þa eorþan willaþ forswelgan*).[29] The rupture of the earth is represented by a metaphorical "speech"—when the text is ruptured its divine sub-text, its hidden secret, bursts forth as speech. The world comes "alive," animated by the return of divine presence through the rupture of the sky. The earth returns to its primeval condition as the deep "devours" the land, returning the surface of the world to the undifferentiated and unsignifying state that characterized it before God divided land and water. The apocalyptic scene develops even further, however, until on the fifth day,

> [...] æt underne se heofen tobyrst from þæm eastdæle oþ þone westdǣl, ond þonne eall engla cyn lociaþ þurh þa *ontȳnesse* on mannacynn. Þonne geseoþ ealle menn þæt hit wile beon æt þis worlde ende. Fleoþ þonne to muntum ond hie hydað for þara engla *onsyne*, ond þonne cweþaþ to þære eorþan, ond biddaþ þæt heo hie forswelge ond gehyde ... ond þonne hie cweþaþ to þæm dunum ond to þæm hyllum, 'Feallaþ ofor us, ond us bewreoþ ond gehydað, þæt we ne þurfon þysne ege leng þrowian æt þyssum englum. Nu is eall gesyne þæt we ǣr behȳded hæfdon.[30]
>
> at the third hour the heaven will burst open from the East part to the West part; and then all angel-kind will look through the *opening* at mankind. Then all men will see what it will be at this world's end. Then they will flee to the mountains and hide themselves, because of the angels' countenance, and then they will speak to the earth, and beg it to swallow and hide them ... and then they will say to the hills

> and to the mountains: "fall over us and cover us and hide us that we need no longer suffer because of these angels. Now all is revealed that we had previously hidden."

This passage is dense with imagery of opening, closing, speaking, devouring, and burying. The two italicized words in my translation represent terms whose semantic fields bear crucially on the meaning of this passage. Thus the translation of *ontȳnes* as "opening" and *onsȳne* as "countenance" should be taken as placeholders that necessarily reduce the impact of the symbolic texture evolving in this passage. *Ontȳnes*, "opening," derives from the verb *ontȳnan*, "to open" or "to make an opening," and takes a second meaning, "to disclose or reveal."[31] The sense "to allow to burst forth" suggested by Bosworth's Dictionary seems primarily to be based on the example in this homily, but the verb is used frequently to describe the opening of mouths.[32] Its use throughout the corpus suggests a special theological valence, as it refers frequently to the opening of the door of heaven, to the opening of one's eyes or ears to divine law, or to revelation. In the Cambridge Psalter, *ontȳnan* is linked with the verb that conveyed the "growling" of the ruptured earth above, *gremetian,* which glosses Latin *rugiens*, the roaring and of lions in Psalm 21:14 ("They have opened [*ontyndon*] their mouths against me as a Lion ravening and roaring [*grymytiende*]").[33] This anonymous homily representing revelation thus borrows scriptural imagery to depict the "opening" of the material world and the ferocious bursting forth of divine reality, likened to an opening mouth and a bursting forth of sound.

Ontȳness thus simultaneously signifies the rupture in the heavens and reinforces the earlier suggestion that the upheaval of the earth lets forth a kind of speech. The face is a traditional symbolic guarantor of authenticity, opposed to the mediation of writing as it was when Augustine imagined angels knowing God without text in the "face to face of countenances."[34] In Old English, this word for "countenance" describes a person's face, or their visible appearance, or their coming into view as a thing to be looked upon. In biblical locutions, *ansȳn* specifically refers to the presence of abstractions like "wisdom" or "sin" and, furthermore, the presence of God.[35] Lastly, *ansȳn* also suggests any superficial surface like those of heaven or earth. It glosses Latin *superficies*, for example, referring to the exposed surface of a crypt.[36] These words thus reinforce the analogy between the boundary of the firmament and the page of a book, explicitly made at the start of the homilist's depiction of apocalypse above. This is a bidirectional metaphor in that, if the heaven is like a page that when rent, releases the presence or the speech of the author, so too a page of writing can be seen as a veil beneath which truths are stored *in potential*, even in the individual letter where thoughts are "bound … lest they slip away into oblivion."[37] This text thus presents

a dramatic, archetypal scene of concealing and revealing. It depicts a hierarchy of representation in which the unbearable, unmediated truth of God is hidden behind the text of the world. Once that "page" is torn open, divine reality issues forth as speech, as if it had been stored as signifying potential in the text. The terrified response of humanity is immediately to attempt a retreat to mediation, to place a new veil of material between themselves and the angelic vision: hiding beneath the hills and mountains. The anonymous homilist's vision of the hidden/shown is profoundly connected to Wilkins's understanding of encryption as a part of the human dilemma in which "imperfect" beings seek communion beyond our corporeal capacities and imagine deeper meanings hidden beneath the surface of our signs.

If this homily stages a cryptographic scene meant to reflect theological reality, Old English literature nevertheless includes many more literal scenes of secret communication, frequently involving runes—or *rūnstafas* "rune-letters"—as they called them. In several Old English poems, including *Beowulf*, runes function as logographs, abbreviating their rune-names. The rune ᛟ, for example, had the phonetic value /ɛ/ and was called 'eþel.' It stands in for that word, which means "homeland," in *Beowulf* and other Old English texts.[38] On the face of it this runic practice is little more than a conventional shorthand, but more complex practices in Old English poetry suggest that Anglo-Saxon writers saw runes as ways of hiding and containing more than a surface meaning. Runes thus modeled semiotic principles of secrecy that applied to all text. Most famously, one Old English poet encrypted his name in the poems called *Juliana*, *Elene*, *The Fates of the Apostles* and *Christ II*. The runic letters that spell his name, with the exception of the first two, had rune-names that were also common Old English nouns. Cynewulf inserted the runes that spell out his name in these verses as substitutes for nouns so that they simultaneously contribute to the meaning of poetic phrases and encrypt his name in the text.[39] The reader of these poems must know the conventional names of runes, but in some cases must also determine the sense in which Cynewulf intended them, in order to reconstruct a sensible interpretation of the poem, a task that has caused some dispute. Cynewulf's acrostic sensibility demonstrates a ludic awareness that graphic forms can signify in symbolic, extra-phonetic ways—as Isidore's *Etymologies* suggested—so that they may be manipulated to encode meaning in layers.

Cynewulf exemplifies this cryptographic mindset, but runes similarly appear in several Old English riddles and an anonymous poem known as *The Husband's Message*. The theme of secret writing in *The Husband's Message* is curiously reinforced by time and chance in folio 123r of the Exeter Book, where the poem is found. It is badly damaged, leaving swathes of the poem unreadable and necessitating that many half-lines must not simply be reconstructed but guessed. The literary technique of

personification is characteristic of Old English riddles, in which the solution of the riddle is usually the identity of the speaker—swords, pens, or gospel books, for example—who speaks enigmatically in the first person and frequently ends by adjuring their audience to "saga hwæt ic hatte" (say what I am called). The riddles themselves, then, form verbal encryptions of identities that nevertheless invite, or challenge, us to decode them. Situated in the Exeter Book among the hundred or so riddles to be found there, *The Husband's Message* participates in their enigmatic strategies, both literary and graphic, but with the added complexity that the personified object is itself a secret message. The final lines of the message and of the poem are delivered in a "runic cypher" that functions as Cynewulf's signature did, though its meaning has proved far more difficult to interpret.[40]

This poem depicts a written document that speaks on its own behalf, not to transmit the content of its message, but to describe that content and to relate the voyage of transmission. This engraved piece of wood delivers its content across the great distances indicated by sea voyage (line 5), expressing a husband's message of love and a hope to be reunited with his wife. A message between an isolated husband and wife may not have been the opportunity for cryptography that Wilkins imagined when he suggested that cryptography was a natural extension of the human need for well-being through "contracting and communing" with others. Yet, this scene constitutes a noteworthy example of the human context Wilkins evokes. As writing, the titular message promotes a "discourse with them that are remote from us, not only by the distance of many miles, but also of many ages," to recall Wilkins's formulation, as it both speaks to a wife separated from her husband by an ocean and encourages her to remember oaths spoken in the past. It asks specifically that the "daughter of princes" remember previously sworn oaths and intimacies.

> Hwæt, þec þonne biddan het se þisne beam agrof
> þæt þu sinchroden sylf gemunde
> on gewitlocan wordbeotunga,
> þe git on ærdagum oft gespræcon,
> þenden git moston on meoduburgum
> eard weardigan, an lond bugan,
> freondscype fremman.
>
> (lines 13–19a)[41]

> Indeed, he who engraved this beam commanded me ask you, beautiful one, to remind yourself in your mind of the promises the two of you often spoke in earlier days, while you were both able to make

> your friendship in the mead-towns, keep to your native soil, dwell in one land.

The message, and the poem, close with a similar reminder of oaths spoken in the past:

> Gehyre ic ætsomne ᛜᛋᚱᛜ geador
> ᛜᛉᛜᚦᛜ ond ᛜᛗᛜ aþe benemnan,
> þæt he þa wære ond þa winetreowe
> be him lifigende læst wolde,
> þe git on ærdagum oft gespræconn.
>
> I hear them together affirm by oath, *sigel rad* together *eard wynn* and *man* that he wished the pledges and bonds of friendship to endure through all his life, those which the two of you often spoke in past times.[42]

The sequence of rune-names in translation reads, sail-road-earth-joy-man, and it has been proposed that it was thus intended to convey that its recipient "take the sail-road, i.e. sea, to the place where you will find joy with your husband." Or, if we understand the second rune to be "sun" rather than sail, the message instructs her to head south.[43] In considering this poem's characterization of written messages, it may be less important to decipher this message than it is to perceive the dynamics of communication that writing creates. *The Husband's Message* emphasizes the intimacy of the message delivered *onsundran* that is, separately from others (line 1), across divides of time and space.[44] It thus evokes several important assumptions about the function of writing as a mediator and as a stimulus to memory. It imposes a radical, almost paradoxical, separation between the medium and the message and a corollary separation between the reminder and the promise itself "spoken" in a previous time. The speaker of the poem is not the voice of the man who "engraved" (*agrof*, line 13) this message; nor does it speak the actual message: it is rather the voice of the medium—the engraved stick that bears the message. Similarly, the message does not form an oath or promise itself, but asks simply to reiterate or draw into mind oaths previously taken. The text or writing of the message is, likewise, notably invisible throughout the poem, until it finally manifests in the runes that have puzzled interpreters of *The Husband's Message*.

In *De tempore rationum* (c. 725), Bede describes a letter-substitution encryption that monks may use to pass secret messages to each other "or else fool the uninitiated as if by magic."[45] *The Husband's Message* suggests that the secrecy of such encrypted messages differs in degree rather than kind from writing *per se*, which also participates in a secrecy

that separates the writer and his audience from immediate social contexts. Writing enables a privacy that in this poem is depicted as a form of intimacy, but which in poems like *Elene* or *Solomon and Saturn I* marks the potential for division and deceit. In *Elene*, Jewish scholars, well-versed in *fyrngewritu* (ancient writings) use their mastery of these texts as a way to manipulate history and hide the secret location of the true cross. Elene undoes their deceit by forceful, and oral, interrogation just as the power of prayer in Ælfric's "Life of Saint Basil" undoes the power of the Devil's written contract.[46] Similarly, in *Solomon and Saturn I*, Saturn has learned the esoteric knowledge of the distant lands by means of *gebregdstafas*, a unique word that at a literal level suggests a form of writing but whose semantic field also makes clear reference to deceit, malice, and sorcery.[47] All writing, that is, seems to entail a secret.

The concern with writing—and especially with secret writing—so concrete in *The Husband's Message* resonates throughout the corpus of Old English literature, sometimes directly and sometimes more obliquely. In our modern context, cryptography is part of a world of complex mathematics and high-powered computers, but for Anglo-Saxon authors, like Wilkins, every practice of signification could be seen from within the Liberal Arts and bent toward the ultimate goal of communion with God. The substitution of runes for Roman letters, or for words, was in their eyes only the most literal manifestation of a truth about all signs; the capacity of writing to store and silently convey words, thoughts, intimacies, and oaths across both time and distance held a potent grip on the Anglo-Saxon imagination. Attempting to explain how knowledge of the inscrutable could be had in this world, Augustine wrestled persistently with the nature of signs and things. In Anglo-Saxon literature like that surveyed here, we catch a hint of the idea that cryptography models a form of communication through which the secret knowledge of God might pass, obscure but accessible, from the realms usually forbidden to men. The very secrecy that separated human beings from God and from each other, the Blickling Homily for Easter Day suggests, could also be a vehicle of sublime and therefore terrifying intimacy. Like the ocean boundary that separated the husband and wife of this poem, the firmament posed a forbidding boundary between the perceptual world of men and the Divine reality they hoped to understand.

Notes

1 John Wilkins, *Mercury, the Secret and Swift Messenger* (London: Printed by I. Norton, for John Maynard, and Timothy Wilkins, 1641), 2. St Augustine expressed this same idea in his *Confessions* (13.5) when he wrote that the "supercelestical peoples … have no need to look up at [the] firmament, or by reading to know [God's] Word. They always behold your face, and, without any syllables of time, they read upon it what your will decrees." *Confessions*, trans. John K. Ryan (New York: Image Books, 1960), 346.

2 Wilkins, *Mercury*, 2.
3 Ibid., 3.
4 Ibid., 6.
5 Umberto Eco, *Semiotics and the Philosophy of Language* (Bloomington: Indiana University Press, 1986), 173.
6 This tradition largely springs from Georg Simmel's, "Sociology of Secrecy and of Secret Societies," *American Journal of Sociology* 11 (1906): 441–498.
7 Shawn Rosenheim, *The Cryptographic Imagination: Secret Writings from Edgar Allen Poe to the Internet* (Baltimore, MD: Johns Hopkins University Press, 1996), 2.
8 Rosenheim, *Cryptographic Imagination*, 2.
9 "The wonders of visible creation, are the footprints of our creator," (*vestigia quippe creatoris nostri sunt mira opera visibilis creaturae)* wrote Gregory the Great, mobilizing a concept of natural signs as "footprints" which remain existentially connected to their referent as a guarantee of meaning. *Moralia in Job* 26.12.17; On this notion of footprints as signs see Carlo Ginzburg, "Clues: Roots of an evidential Paradigm," in *Clues, Myths, and the Historical Method* , trans. John and Anne C. Tedeschi (Baltimore, MD: Johns Hopkins University Press, 1992), 96–214. See also, Giovanni Manetti, *Theories of the Sign in Classical Antiquity*, trans. Christine Richardson (Bloomington: Indiana University Press, 1993). Explication of the footprint metaphor in Anglo-Saxon literary culture can be found in E.J. Christie, "Writing," in *A Handbook of Anglo-Saxon Studies*, ed. Jacqueline Stodnick and Reneé Trilling (Oxford: Wiley-Blackwell, 2012), 281–294 and "Writing in Water," *postmedieval: A Journal of Medieval Cultural Studies* 3, no. 1 (2012): 27–45. On the role of letters in the "rudimentary process of reading" in Anglo-Saxon England see Malcolm Parkes, "Rædan, Arecan, Smeagan: how the Anglo-Saxons Read," *Anglo-Saxon England* 26 (1997): 1–22, 5–6. On the importance of the letter as an isolable unit of meaning in medieval literary theory, see Martin Irvine, *The Making of Textual Culture: "Grammatica" and Literary Theory, 350–1100*. Cambridge Studies in Medieval Literature (Cambridge: Cambridge University Press, 1994), 97–104.
10 James Bono, *The Word of God and the Languages of Man: Interpreting Nature in Early Modern Science and Medicine. Volume 1: Ficino to Descartes* (Madison: University of Wisconsin Press, 1995), 17.
11 Martin Elsky, *Authorizing Words:Speech, Writing, and Print in the English Renaissance* (Ithaca, NY: Cornell University Press, 1989), 149.
12 Irvine, *The Making of Textual Culture*, 248; cf. Jane Chance, *Medieval Mythography, Volume 1: From Roman North Africa to the School of Chartres, A.D. 433–1177* (Gainesville: University Press of Florida, 1994), 21–22.
13 Irvine, *Textual Culture*, 250.
14 Ibid., 250–251.
15 *Bede on Ezra and Nehemiah*, trans. Scott DeGregorio, Translated Texts for Historians 47 (Liverpool: Liverpool University Press, 2006), 1.
16 Parkes, "Rædan," 4.
17 Irvine, *Textual Culture*, 212; cf. Parkes, "Rædan."
18 *The Etymologies of Isidore of Seville*, trans. Stephen Barney *et al.* (Cambridge: Cambridge University Press, 2006), 39–40.
19 Lines 2b–3b. George Philip Krapp and Elliot V.K. Dobbie, eds., *The Exeter Book*. ASPR III (New York City: Columbia University Press, 1936), 156–157.
20 Lines 13a–14b. Krapp and Dobbie, *The Exeter Book*, 134.

21 John Hill and James E. Cross, *The Prose Dialogue of 'Solomon and Saturn' and 'Adrian and Ritheus'* (Toronto, ON: University of Toronto Press, 1982), 62.
22 Text and translation from Martin Blake, ed., *Aelfric's De Temporibus Anni*. (Cambridge: D.S.Brewer, 2009), 76–77. I have slightly modified the text, replacing tironian abbreviations with the word "and." Paul's experience in the third heaven is recounted in 2 Corinthians 12: 2–4, "And I know such a man (whether in the body, or out of the body, I know not: God knoweth), that he was caught up into paradise, and heard secret words, which it is not granted to man to utter."
23 Michael Lapidge and James L. Rosier, trans., *Aldhelm: The Poetic Works* (Cambridge: D.S. Bewer, 1985), 93.
24 See Michael Lapidge, "The Hermeneutic Style in Tenth-Century Anglo-Latin Literature," *Anglo-Saxon England* 4 (1975): 67–111.
25 Krapp and Dobbie, *The Exeter Book*, 201.
26 The Old English text of the homily is taken from Richard J. Kelly, *The Blickling Homilies: Edition and Translation* (New York: Continuum, 2003), 64. Translations are my own.
27 Kelly, *Blickling Homilies*, 62; The homilist here alludes to Revelations 6:14 c.f. Isaiah, 34:4.
28 Ibid., 64
29 Ibid.
30 Ibid.
31 Joseph Bosworth and Thomas Northcote Toller, *An Anglo-Saxon Dictionary based on the Manuscript Collection of the Late Joseph Bosworth, D.D., F.R.S.* (Oxford: Clarendon, 1898), s.v "ontȳnan."
32 Bosworth and Toller, *Anglo-Saxon Dictionary*, s.v. "ansȳn."
33 Karl Wildhagen, *Der Cambridger Psalter*, Bibliothek Der Angelsächsischen Prosa 7 (Darmstadt: Wissenschaftliche Buchgesellschaft, 1964), 278. Cited from *The Dictionary of Old English Web Corpus*, compiled by Antonette diPaolo Healey with John Price Wilkin and Xin Xiang. (Toronto, ON: Dictionary of Old English Project 2009).
34 Jacques Derrida, *Of Grammatology*, trans. Gayatri Chakravorty Spivak (Baltimore, MD: Johns Hopkins University Press, 1977), 138. On Augustine see note 1 above as well as Jesse M. Gellrich, *The Idea of the Book in the Middle Ages: Language, Theory, Mythology, and Fiction* (Ithaca, NY: Cornell University Press, 1985), 23–33.
35 *Dictionary of Old English on CD-ROM A-F* (Toronto, ON: Dictionary of Old English, 2004). s.v. "ansȳn" meanings 2.f and 3.a.
36 *Dictionary of Old English on CD-ROM A-F*, s.v. "ansȳn" 5.b.
37 *The Etymologies of Isidore of Seville*, trans. Stephen Barney *et al.*, 39.
38 Dieter Bitterli, *Say What I am Called: The Old English Riddles of the Exeter Book and the Anglo-Latin Riddle Tradition* (Buffalo, NY: University of Toronto Press, 2009), 88.
39 See Ralph W.V. Elliot, "Cynewulf's Runes in *Christ II* and *Elene*" and "Cynewulf's Runes in *Julianna* and *The Fates of the Apostles*," in *Cynewulf: Basic Reading*, ed. Robert E. Bjork (New York: Garland, 1996), 281–292, 293–308 respectively.
40 See Ralph W.V. Elliot, "The Runes in *The Husband's Message*," *Journal of English and Germanic Philology* 54, no. 1 (1955), 1–8; Bitterli, *Say What I am Called*, 84–85.
41 Krapp and Dobbie, *The Exeter Book*, 226.
42 The third letter of the first word, *gehyre*, is illegible in the manuscript. This word may also be "gecyre" or "I turn," in which case the line might also suggest combining or switching the letters.

43 On both of these possibilities, see Elliot, "The Runes in *The Husband's Message*," 7.
44 Krapp and Dobbie, *The Exeter Book*, 225.
45 Faith Wallis, trans., *The Reckoning of Time*. Translated Texts for Historians 29 (Liverpool: Liverpool University Press, 1999), 11. This same code is demonstrated in a fragmentary vernacular riddle, which points out that it is "lytel cræft" (not difficult) to communicate by such means even if one lives with many men. See Max Förster, "Ae. fregen 'die frage,'" *Englische Studien* 36 (1906): 325.
46 Gabriella Corona, ed., *Aelfric's Life of Saint Basil the Great: Background and Context* (Cambridge: D.S. Brewer, 2006).
47 See E.J. Christie, "By Means of a Secret Alphabet: Dangerous Letters and the Semantics of *Gebregdstafas* (*Solomon and Saturn I*, Line 2b)," *Modern Philology* 109, no. 2 (2011): 145–170.

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5 The Printing Press and Cryptography

Alberti and the Dawn of a Notational Epoch

Quinn DuPont

In the opening pages of *De componendis cifris* (1466), Leon Battista Alberti (1404–1472) introduced his famous "cipher wheel" while discussing the printing press.[1] In conversation with the papal secretary Leonardo Dati, Alberti noted how the newly invented "system of moveable type... brought us to similar appreciations… [of] strange characters with unusual meanings known only to the writers and receivers, called ciphers."[2] This reference to the movable type press is the first and only in all of Alberti's corpus.[3] But why would Alberti make reference to movable type in a cryptography manual? Kim Williams, the work's modern translator, suggests (on the authority of Anthony Grafton) that Alberti intended the story to function as a dedication, with the hope of having his work printed. This is not quite correct,[4] and either way, this reference to movable type is more complicated and important than either Williams or Grafton make it out to be. I will show that, instead, we have good reason to think Alberti's reference to the movable type press was a perfunctory admission that the invention of the movable type press had an impact on his thinking while developing his new form of cryptography. But how and why? What is it about the invention of the movable type press, still new and exciting in Alberti's day, that contributed to the development of the polyalphabetic cipher wheel?

In this chapter, I argue that both the movable type press and the cipher wheel utilized reproducible, modular, indexical, and combinatory forms of representation. In effect, the cryptographic technology Alberti developed was a new kind of writing, which offered unique capacities for technical representation. This representational invention departed from the ways that prior artistic and writing technologies worked, and it ushered in new ways of thinking about the world. Of course, Alberti was far from the first to design and use cryptography; before his invention, however, modes of expression were dominated by, and exemplified through, the oral and plastic arts, which were understood as "mimetic" or imitative. The invention of the movable type press was actually a first major step away from mimetic representation. The cipher wheel further refined and deepened how these representational logics were deployed, which was followed by numerous "code" machines.

Alberti's novel contribution was to recognize the latent capacities of the movable type press and to highlight the ways these capacities can be used for new kinds of representation. While printed text introduced new ways of thinking about the world and our ability to represent and understand it, cryptography went further by not only digging deep into the fabric of nature (in the sense of "decrypting" the Book of Nature) but also by harnessing "notational" strategies that keyed into natural identities, and formed new, artificial ones to enhance human control and dominion over the world. In doing so, Alberti inaugurated a "notational epoch." Of course, neither Alberti nor his followers saw the future so clearly, and their work (including developments in cryptography) continued to vacillate between ancient mimetic representational strategies and future notational ones. With considerable hindsight, we can see that Alberti's invention of the cipher wheel was one of the first significant technologies to "compute" the world, anticipating developments by Gottfried Wilhelm Leibniz, George Boole, and other figures traditionally considered part of the lineage of computing.

I explore Alberti's invention of the cipher wheel in the context of the movable type press to highlight the ways in which the material and representational bases of writing were reconfigured. Indeed, the histories of these cryptographic processes have unique pathways, captured in the logics of reproducible, modular, indexical, and combinatory forms of representation, and therefore leave to one side the theory of mimesis that originally led discussions of representation and eventually proved insufficient to explain the novel forms of representation. As Alberti discovered, polyalphabetic encryption, made possible by the cipher wheel, pushed representation and its operationalization through language to the breaking point, such that (in its extreme), encrypted text ceases to resemble the world at all and has no real meaning for its human originators (that is, it is not directly interpretable).

This representational reconfiguration, from writing to "plaintext" and "ciphertext," was perhaps best and first understood by Alberti, but Alberti was not limited to this single trajectory. Sometimes Alberti consciously drew on the ancient theory of mimesis, yet he also worked to overturn this traditional model, to develop notational technologies and explore their conceptual affordances.

The History of Notation and Cryptography

Alberti's *De cifris* was a major turning point in the history of cryptography, which historian David Kahn called the start of a "new species."[5] This work was also a major turning point for writing, as one of the first fully realized, practical examples of a working system of "notation." As I use the term, "notation" is an unambiguous, discrete set of marks (or utterances, etc.). A "notational *system*" includes the semantics of

notational marks, as they either reach out to the world, or reach out to another sets of marks (in "indexical" or univocal ways).[6] Encryption, as Alberti realized, sets up a system of unambiguous, discrete marks (ciphertext) that indexically refer to other marks (plaintext), which in turn may refer to the world (as in the case of English writing), or not (as in the case of gibberish). And because the marks are indexical, the process can be reversed (encryption/decryption), without losing the "original" meaning.

Alberti described these notational mechanisms in *De Cifris*, using his design for a cipher wheel as an example of how to operationalize the technique. The cipher wheel is a mechanism that permitted easy realignment between the "index" key and a plaintext alphabet (being indexical and mutable). Analytically, the cipher wheel requires a notational system: a set of unambiguous, discrete marks that are aligned and realigned "semantically" (in the sense that the marks refer to, stand in for, or take on the "meaning" of other marks). Moreover, this "indexical and mutable" feature of the cipher wheel was essential to Alberti's fundamental "security" insight—by changing the index during encryption, multiple "alphabets" can be used, which greatly increases the complexity of the resulting ciphertext. This idea of changing the index during encryption is now called polyalphabetic encryption.

Alberti's work therefore required notation, and it marks an important chapter in the history of notation. However, the history of notation is still unwritten, despite its central importance for the development of mathematics and computation alike.[7] Here, I also explore a small but important chapter in the history of notation, which connects at multiple points to the larger history of cryptography (as the other works in this book show, the history of cryptography is also largely unwritten, but is starting to receive serious scholarly attention). By focusing on Alberti's technological developments, the conceptual refinement of systems of representation is also revealed. In this regard, Alberti was neither the first nor the last figure in the development of a broader "notational epoch," but he was at an important inflection point where notation began to take over from mimesis.

This phrase, "notational epoch," is critical to my description and therefore needs some explanation. I consider Friedrich Kittler's description of a "discourse network"—a configuration of the network of technologies and institutions in an epoch that allow "a given culture to select, store, and process relevant data."[8] This "discourse network," in fact, literally translates to "systems of writing down" or "notational systems" in Kittler's original German (*Aufschreibesysteme*). In his "Foreword" to Kittler's *Discourse Networks, 1800/1900*, David Wellbery notes that *Aufschreibesysteme* refers to a level of material deployment prior to questions of meaning; that is, the constraints that select an array of marks from the noisy totality of all possible marks.[9] The

noisy totality of all possible marks, and the system of constraints that select them, are precisely the necessary conditions upon which encryption acts—selecting, transforming, and transmitting *from* the infinite variety of possible forms of expression *to* the potentially massive combinatory space of ciphertext. In other words, the notational epoch is a particular discourse network, made possible by socio-technical apparatuses (such as encryption technologies) that work *on but not through* mimetic representation (such as natural language or images).

The particular discourse network under consideration here, I argue, begins in 1466 when Alberti wrote *De cifris*, leading to the growth of a new species of cryptography. Indeed, this notational epoch cuts across those networks previously identified by Kittler (1800 and 1900), and is still very much in force today: we now deal with codes and their execution more than ever before, and increasingly, these codes are cryptographic.

Mimesis and Resemblance

Mimesis is the traditional theory of mediation. The history of mimesis reveals its connections first and foremost in the process of making art, but since it is a flexible theory of representation, it also works for many modes of expression. The key feature of mimesis is the duplication of perceived similarity and difference that links an expression to its object (or, in semiotic terms, between signifier and signified). As the theory of mimesis developed in response to changing artistic and technical practices, primarily through the late Middle Ages and early Renaissance, this function of duplication was replaced with repetition and resemblance.[10] Crucially, as I describe below, mimesis fails to adequately describe the particular way that technical media based on notation link subjects and objects.

The origins of mimetic theory are found in the shift from orality to writing. Speech was seen as more natural and more "present" than writing,[11] so the latter came to be seen as a kind of duplication of speech and oral expression. The most famous examples of mimetic expression are in Homer's epics, originally composed in an oral world. The formulaic feel of Homer's works is a consequence of being "stitched together" from standardized expressions (originally recited by "rhapsodes," a Greek term meaning "to stitch song together").[12] Additionally, because of this oral mode of composition, and the lack of writing at the time, Homer's work reflects an inherent mnemonic structure. Prior to writing, strategies for memory had to be an internal part of the expression, which is why Homeric expression includes mnemonic strategies, such as rhythm, repetition, addition, and redundancy.[13] That is, human expression and representation in oral cultures differed significantly from literate ones.

Plato lived while writing was still beginning to proliferate. Plato believed that speech was a duplication of more originary "forms," and

writing doubly so. Because speech was seen as a duplication of a proper reality, Plato believed that a certain kind of distortion would often occur during oral expression, sometimes leading to the propagation of false and therefore immoral beliefs. This meant, according to Plato, that duplicative, or "mimetic" oral practices should be restricted. In fact, the followers of Homer are singled out by Plato in the *Republic* for promoting this bad kind of duplication. In Book III, Socrates and Adeimantus discuss the ideal composition of their proposed state, turning to the question of mimesis as a kind of performance or "story-telling."[14] Certain public discussions must be restricted, Socrates argued, because they would be liable to be imitated by the youth and thus bring about negative effects. Rather than revealing truth, the imitative effect forces the poet to "hide himself," and suggests a lack of mastery or skill, or failing to "achieve distinction."[15] Therefore, poetry, and all imitative arts should be restricted in both content and form.

In Book X of the *Republic*, Plato continues his discussion of how the origins of mimesis are irrational and illusory and of how the powerful imitative effect promotes troublesome personal and social behavior. In this book, Socrates argues that there are three levels of reality,[16] exemplified by the metaphorical makers of a couch: first, there is the idea of a couch, made by god—the "natural maker"—which is necessarily singular; second, material couches made by craftsmen who strive to be like god, imitating the original form but who do not "truly make [*poiesis*] the things themselves;"[17] and third, the imitative artists, such as painters, who do not imitate the original but simply imitate the (imitated) material works of craftsmen. To show how false and illusory the craftsman and especially the painter are, Socrates imagines a "clever and wonderful fellow" who walks around with a mirror and claims to be "making" all the things of the world as he points it toward objects.[18] This fellow with the mirror, obviously, is fabricating only the "appearance" of things, not their real form. Writing that imitates speech was thought to be like painting and therefore, according to Plato, failed to capture the true reality of things.

For Aristotle, the central concern of mimesis was *muthos* or "plot-structure," which offered a significant reimagining of Plato's theory of mimesis and led Aristotle to believe that mimetic practices were potentially beneficial. In Aristotle's *Poetics*, the "plot-structure" (*muthos*) drives narrative expressions not simply as the abstract shape of a plot but as the totality of the represented action with all its causal connections and development.[19] Aristotle argued that *muthos* was not simply the process of stringing together mimetic actions into a narrative but, rather, it hinged on good plot structure that must be "complete in itself, as a whole of some magnitude."[20] This "whole" must have a beginning, middle and end that are "naturally" connected. It is precisely the *muthos* structure that creates a feeling of completion, direction, and justifiable

connection within a plot (versus a plot that lacks compelling features, zigging and zagging without reason). According to Aristotle, good plot-structure is created by mimesis' connection to reason, not (false) "inspiration" or madness, as Plato had argued previously.

While too sophisticated and various in their approaches to be described fully here—Plato opposing mimesis in favor of his own ontological approach, Aristotle seeing considerable value in mimetic arts through its channeling of *muthos*—ancient views of representation can be summarized as fundamentally configured around illusion and verisimilitude. As the ancients understood it, making art, and making representational expressions more generally, relied on a duplication of perceived reality through similarity and difference. After Plato and Aristotle, the question of representation, through the traditional theory of mimesis, developed further and came to stand in for the similar actions of repetition and resemblance. From the fall of Rome until the Renaissance, the Greek term and the original philosophical concept of mimesis fades somewhat, only to be replaced with an extremely rich semantic web of repetition and resemblances. As representation became a form of repetition, the theory saw that the "universe… folded in upon itself."[21] By the end of the sixteenth century, all aspects and offshoots of mimesis co-existed and interrelated in complex ways and became increasingly open to reform and revolution.

One of the most striking changes prior to Alberti's upheaval of mimesis came from the Catalan thinker Ramon Lull (1232–1315). In his *Art* (*Ars*), described over numerous works and revisions, Lull reconfigured the theory of representation that previously relied on the complex web of resemblances, as it had been handed down to him through ancient and medieval transmission. In his *Art*, Lull replaced the use of images with notation.[22]

Reflecting early concerns around the use of writing and its impact on memory, Lull's *Art* also sought to improve memory techniques. As Lull saw it, following Aquinas and other medieval thinkers, (mimetic) images had crept into the memory arts. (The memory arts were an ancient system, first elaborated by rhetors such as Quintilian, that enabled prodigious feats of memory.) Images were introduced as a way to fix items in memory and were thought to be efficacious because of their vivid (and therefore easily remembered) style of representation. However, drawing on Plato's critique of mimesis, Lull opposed the use of mimetic representations and developed a system that he saw as capable of aiding memory without using mimetic representation.[23] In place of mimetic images, Lull developed a system of clear and precise *notation* to help hold items in the memory.

In Lull's *Ars Brevis,* the first "figure" arranged the divine "dignities" (first causes) into two circles (or horizons), with each segment designated by a principle aligned against another.[24] The outer ring of nine letters

(B, C, D, E, F, G, H, I, K) aligns against the inner ring of dignities, arranged in *convenientia* (in the first figure, which is denoted by "A", the dignities are goodness, greatness, eternity, power, wisdom, will, virtue, truth, and glory). As the reader compares inner and outer circles, new prepositions are created, such as "goodness is great" and "greatness is good."[25] In figure four of the *Ars Brevis* (see Figure 5.1), Lull introduced a further ring while removing the names of the dignities, and he made the circles rotate against one another. With this tool, as the dignities rotated they revealed new connections for its user, who interactively explored the resulting predicates.

Each "dignity" could be combined according to particular rules, which amounted to a method for investigating reality. That is, this method was a way to do *work* and to actively investigate or "compute" the world, quite unlike existing memory systems that were static and merely held items in memory as *loci*. Lull's development of an active system using rotating wheels, with its particular history of representation, was an important precedent for Alberti's invention of the cipher wheel.[26]

Immediately following Lull's invention, many new code technologies emerged. It is within this context of mimesis and resemblances that Alberti designed his cipher wheel for polyalphabetic encryption. Ultimately, the practice of cryptography introduced new technical challenges, many of which were poorly captured by the flagging theory of mimesis. Guided by these technical challenges, cryptographers offered early critiques (and sometimes accommodations) to extant theories of representation. The raft of cryptographers who followed sometimes

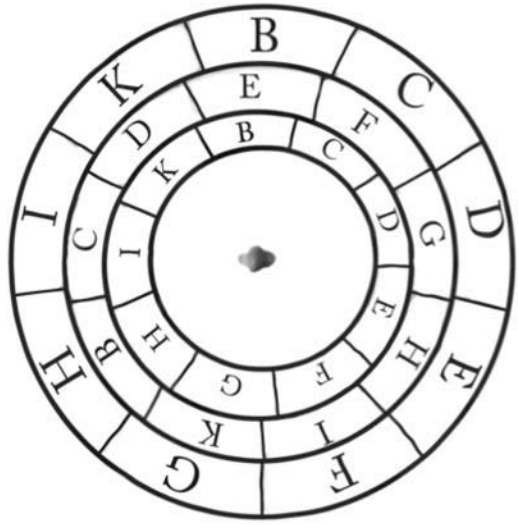

Figure 5.1 Reconstruction of the fourth figure, from Lull's *Ars Brevis*.[27]

also sought to remove resemblances, and their occult powers, from their cryptographic systems. In late Modernity, scholars like Descartes would continue to modulate mimetic theory, arguing that the category of resemblance should be removed entirely from modern epistemology, and scholars such as Leibniz would develop similar notational systems specifically for "computation."

Type and the Emergence of Plaintext

By the end of the fifteenth century, mimetic theory was undergoing rapid change as new technologies for communication, computation, and memory emerged. Alberti's notational innovations are an important part of this history, reflected in both his cryptographic and architectural work, which developed new kinds of ordering and modes of expression. Retrospectively, we can see that by leveraging the logics inherent in his notational innovations, Alberti was an impetus to the dawn of a new epoch in representational technologies. Prior to Alberti, one of the key technological advances in the fifteenth century was the invention of the movable type press, which, I argue, served as a prototype for Alberti's cryptographic system.

All of these systems relied on the transition from natural-seeming techniques and technologies for writing to the emergence of "plaintext," a token-identical form of writing that reflects a reality of the world as already divided into discrete marks, or one capable of being divided into discrete marks (that is, notation).[28] One important example of this trajectory is the history of "decryption" that followed the parallels between the Book of God (scripture) and the Book of Nature. As Peter Pesic has detailed previously, Francis Bacon's cryptological investigations, for example, took advantage of this perceived isomorphism.[29] Seeing that "decryption" could occur in already-textual sources, Bacon reasoned that with the right tools and training, the natural world could also be "decrypted." One of the key features of Bacon's method, however, was to reduce the smooth and continuous world, with all of its complexity, to a set of discrete marks. Bacon noted that the method could be reversed, too, utilizing his "bi-literal" cipher to signify "anything by anything" ("*omnia per omnia*").[30]

The key characteristics of these "plaintext" systems, shared by Bacon's bi-literal cipher, the movable type press, and Alberti's architectural and cryptographic systems, are that they deploy the logics of reproduction, modularity, indexicality, and combination. As I noted at the start of this chapter, Alberti mentioned the movable type press in *De Cifris* not only because the movable type press was an important technological precedent but because Alberti's cryptographic system further developed the implicit logics of the printing press.

Whereas the movable type press required external input for its use, Alberti's innovative cipher wheel worked "algorithmically" through its

special design, as did an architectural plotting device he developed. Alberti's architectural works parallel his motivation in *De Cifris*, which attempt to develop new systems of representation not limited by mimesis. At many points in his architectural work, Alberti avoids drawing on mimetic styles of representation, such as by supplying *rules* (in the same way as algorithms) for all'antica construction, instead of drawings. In fact, according to Mario Carpo, throughout Alberti's entire architectural corpus there are no drawings of ancient monuments, nor even ekphrastic reconstructions. In this regard, Carpo believes, Alberti's architectural theory "cleanses itself" of the practice of "imitation," or mimesis.[31]

Alberti's Notation

In place of mimesis, Alberti utilized a "notational" form of representation when developing his novel machines. Like the movable type press that came before, these can be considered special "writing" machines. In *Descriptio Urbis Romae* (Figure 5.2), Alberti developed an ingenious device to plot the coordinates for a plan of Rome, which has significant parallels to his cryptographic invention in *De Cifris*.[32]

In an effort to avoid the issues involved in scientific and engineering communication that uses mimetic, visual descriptions, and the errors these methods potentially introduce, Alberti developed a tool to draw a plan of Rome. This tool used a list of points, which could be plotted. This special writing instrument—a kind of ruler pinned to the center of a circular horizon—matched notations on the ruler to notations along the circumference of the horizon. The plan of Rome is recreated by first

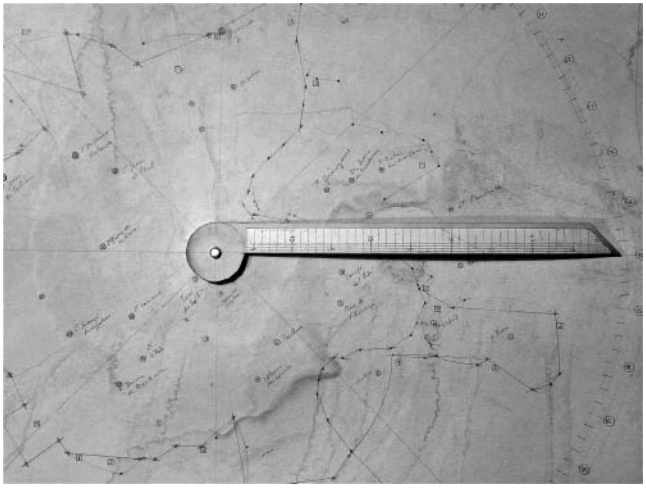

Figure 5.2 Reconstruction of Alberti's *Descriptio Urbis Romae* mechanism. Image used with permission of Patrick Thépot.[33]

plotting data points, and then, in a kind of connect-the-dots way, by drawing the outline.

Carpo calls Alberti's writing instrument a tool for producing "digital images."[34] Indeed, when his plotting machine (hardware) is combined with the appropriate method (software) and fed suitable coordinates (data) it produces "digital" images. In *De statua*, Alberti expands the scope of the mechanism, imagining its use in three dimensions as a way to re-present the human body.[35]

In *De Cifris,* Alberti described his cipher wheel, which could be used to produce polyalphabetic ciphertext (Figure 5.3). The cipher wheel is comprised of two rotating, circular planes that attach to a center pin or string, around which they rotate. Alberti stated that the disk is divided "into twenty-four coequal parts" which he called "houses;"[36] the smaller wheel of the cipher contains "mobile" houses. Together, the two wheels work like a formula (*formulam*), where the relative positions of the houses (the "index") are like a "key."

When the disk is rotated, a new indexical relationship (a "key") is established. The cryptographic "key" is set by aligning two letters: "say such k" Alberti writes, "lies under the upper-case B."[37] Substituting each letter of the plaintext to its "twin" along the other plane encrypts the message. When substituted, each letter comes to stand in for its twin, or comes to take on the "meaning" of the other letter, "thus a common letter, say A, will take on the meaning of another letter, say G…."[38]

It is important to note that if Alberti's desire to print *De cifris* had been realized (it was never printed in his lifetime), the transformation

Figure 5.3 The rotating horizons of Alberti's cipher wheel, attached by string.[39]

from <A> to <G> on the work's pages would have been in no way metaphorical. With movable type, an <A> can be literally replaced with a <G>. From the *material* of movable type to the (pre-symbolic, noisy totality) *real* of cryptography, the substitution <A> -><G> is indexical. That is, each letter's self-identity is required, but of course, unlike mimetic representation, visual similarity between <A> and <G> is not needed (in fact, in order to be considered notational, there must be an in-principle way of determining the difference between <A> and <G>).[40] The system works so long as any thing, natural language or otherwise, can be broken down into letters of plaintext, which are linked through an indexical relationship by the encryption transformation. This singular transformation, <A> -><G>, however, only produces single-alphabet encryption—a useful but marginally superior technology than what existed previously.

Alberti's cipher wheel is more than a handy mechanism for common substitution ciphers; the key cryptographic innovation is the use of multiple alphabets *in situ*. Alberti writes, "after I have written three or four words I will mutate the position of the index in our formula, rotating the disk let's say, so that the index k falls below the upper-case R."[41] By rotating the disk during the process of encryption a "new" alphabet is introduced with each rotation, making cryptanalysis significantly more difficult by increasing the combinatory space.

The reason why it is difficult to cryptanalyse polyalphabetic encryption is because natural languages have "natural" identities and redundancies, most noticeable in word and letter divisions, which are "scrambled" through polyalphabetic encryption by introducing new alphabets.[42] Each particular natural language, and indeed, each form of expression, brings about its own syntactical characteristics. These "natural" syntaxes are why it is possible to imperfectly remediate or translate natural languages. Alberti's cipher works precisely on these "natural" syntaxes. Specifically, he relates the intrinsic qualities ("*De notis literarris quales sese natura*")[43] of Latin letter "orders" to "numeric ratios" ("*numeri rationibus*"),[44] which naturally form vowels and consonants, bigrams and trigrams.[45] Alberti noted that, during encryption, these natural syntaxes (or identities) are first "scrambled" about, but like a dutiful caretaker collecting leaves blowing in the wind, cryptography then rakes the leaves into piles, forcing artificial identities and orders.[46]

Notational technologies like the cipher wheel or the plotting machine in *Descriptio Urbis Romae* offer a number of representational advantages over mimetic technologies. Before the widespread use of notational technologies, first explored with the movable type press, scientific and technical work was fraught with difficulty. Carpo argues that "the pretypographical architect knew… long-distance transmission [using] images… [was] not a trustworthy medium," and "he practiced his craft within these limitations."[47] The problem with images is that when

remediated or copied, errors are likely to creep in with each new copy. Notation, on the other hand, uses a small set of predefined marks (usually an alphabet), therefore less likely to introduce errors during copying, and has an unambiguous identity.[48]

There was also a great deal of economic, diplomatic, and scientific communication and commerce in Alberti's lifetime, requiring new, long-distance (and sometimes secret) transmission. This is why Alberti argued that cryptography was needed—secret, capable of long distance transmission (not as likely to be corrupted), and above all efficient (Alberti called it "commodious" [*scribetur commodius*]).[49] Additionally, in stark opposition to the prevailing forms of handcrafted reproduction and representation (painting, sculpture, carpentry, etc.), Alberti's technologies enabled mass production—mass production of built form (architecture) and mass production of writing (cryptography). Just as Alberti's architectural methods gave rise to "designed" buildings—in distinction to the old handicraft of architecture before him—his cryptographic methods offered order and precise forms of remediation. That is to say, Alberti was a champion of a new kind of "indexical" sameness, but not the sameness of mass production where every piece is identical, as though stamped out from a form or mold. It was the building blocks of letters printed from movable type presses that provided the model from which Alberti developed his notational machines, in architecture and cryptography.

The Printing Press Prototype for the Cipher Wheel

Returning to this chapter's initial provocation, what role did the invention of the movable type press have on Alberti's thinking, and how did this lead to a "new species" of cryptography and the dawn of a notational epoch? Movable type was invented in Alberti's lifetime and was influential to his thinking. Carpo calls Alberti the first "typographical architect,"[50] and the same can be said for his cryptographic work, also inspired by Lull's notational, combinatorial wheels. The invention of the alphabet originally brought forth the necessary identity configurations for writing to become plaintext, but it was the movable type press that made the functional aspects clear.[51] I argue that these functional aspects were logics of reproduction, modularity, indexicality, and combination. Like later computing and calculation machines, Alberti put these typographic logics to work in both his architectural and cryptographic apparatuses.

Reproducibility

The moveable type press changed existing notions of reproducibility. Like those before him, Alberti was familiar with the idea of reproducing identical copies from woodcuts, a pre-Gutenberg technique called xylography. Xylography produced whole "images," typically an etched picture,

but sometimes the reproduction of a complete page including textual elements. Entire books—texts and images together—could, in fact, be printed using xylographic processes, but this "block book" process was rare and may have even originated *after* Gutenberg's invention, as a quick and cheap alternative to movable type. And more to the point, printing from woodcuts, while possible, had serious limitations. Because each successive "edition" introduced the chance of error, block book production was poorly suited for technical works of the sort Alberti was interested in.[52] In fact, the chance of copyist error for pictures was so high that authors typically wrote *textual* (ekphrastic) descriptions of what are fundamentally visual phenomena, such as architectural plans and forms.[53] Alberti was so worried about error that in his architectural works he requested copyists to write out numbers in longhand rather than using numeric symbols, even addressing the copyist directly in several cases.[54]

Avoiding the introduction of errors was one of the principle advantages of typographic expression for the reproduction of technical works. Traditionally, manuscripts were produced by scribes taking dictation. Scribes could be counted on to (somewhat) reliably replicate the correct order of a finite set of marks (alphabetic letters) that represent spoken words, but reproducing technical images and diagrams would have been very difficult. Etched woodblocks were one solution to ensure exact duplication for images, so long as the etching itself was correct, but these tended to get worn and broken over time.[55] For manuscripts, to duplicate a technical image was to invite critical mistakes.

Error propagation is also a real concern for cryptography. Alberti's polyalphabetic encryption "mixes" multiple alphabets with plaintext to result in a kind of "diffuse" ciphertext. So-called "diffusion" and "confusion" techniques are basic methods of encryption, as they frustrate cryptanalytic techniques by "hiding" plaintext more deeply within a combinatory space.[56] As Alberti realized, for any one letter of plaintext the corresponding ciphertext might be several letters, or mixed about in "unnatural" ways. On the other hand, the redundancy of natural languages permits transmission on "noisy channels," since redundant information accommodates errors. For cryptography, however, this redundancy is, ideally, deeply compromised to the point of non-existence. Highly diffuse ciphertext (that is, "secure" cryptography) becomes very "brittle" in transmission. Even a small copying or transcription error may render much or all of the resulting ciphertext impossible to decrypt. Very careful transcription, or error-correction codes (as we use today) are a practical necessity for cryptography.[57]

Modularity

For Alberti, modularity was a byproduct of the introduction of movable type. Creating manuscripts by hand required the inscription of letters *in*

situ (at the time of production), but on a printed page, letters pre-exist as units of (literal) type before the creation of the words in which they occur. Indeed, the "mechanical regularity of print," Roy Harris argues, "confers upon each alphabetical symbol an *independence* and a constant visual identity which no earlier form of writing quite achieves."[58] This concreteness, independence, and regularity of print suggests to its users that letters are distinct from their context, which could be moved about and substituted in modular ways.

In Alberti's writing, the letter became a metaphor for modularity, suggesting that the architectural form of the ciphertext message could be assembled just as a word is created from its constitutive letters. That is, the invention of the movable type press transformed abstract letters from icons in the imagination to fungible but real materials. With the movable type press, it was clear that individual letters (in the form of literal pieces of metal) were distinct, yet produced identical marks as output. Similarly, Walter Ong argues that the invention of movable type much more strongly implied a sense of modularity than by the written alphabet alone. According to Ong, the "discrete" letterforms of the printing press were modular and interchangeable because written letters had long stood as symbols, which, with the introduction of type, became modular forms that could be manipulated. One consequence of this change was that the letter, not the page, became the locus of identity.

Cryptographic systems, such as Alberti's cipher wheel, require pre-existing, modular "plaintext." Plaintext, however, could be nearly anything, so long as the appropriate translations were made. Plaintext is, therefore, the result of turning a subject into notation, which included the various ways that text would be "read off" the Book of Nature, as Bacon later explored. The kinds of "text" to emerge from reading nature were usually alphabetic, however, for example, Bacon also envisioned other marks as suitable types of plaintext. In Alberti's *Descriptio*, numerals and other kinds of notation were also considered possible plaintext marks. We might also look at John Wilkins' cryptographic and artificial language writing as well, in both *Mercury* and the *Essay towards a Real Character and Philosophical Language*, to see notations composed in line or dot form. Whether the marks were letters, numerals, lines, dots, or something else, they needed to be of a kind of mark that could be modularly replaced, because the very act of encryption, as made literally clear with the cipher wheel, was to replace one letter with another.

Indexicality

As print suggested that letters were things, letters also came to be seen as more strongly indexical.[59] Paradoxically, by making letters more concrete, it became easier to see how letters could stand in for more abstract

things, which were previously difficult to combine and analyze, or as would later become critically important, to "compute."

According to Carpo, in his architectural works Alberti sought "indexical sameness," and had a "quest for identical replication."[60] However, Carpo here elides an important distinction between "indexical sameness" and "identical replication." Indexical sameness forms a kind of identity (made possible by, among other things, notational marks), whereas identical replication symbolically links objects through a visual field based on mimetic similitudes. For example, the xylographic printing press certainly did create visually identical books—identical pages neatly organized and bound together to create a unified whole. However, the key to understanding the logic of indexicality that resulted from the invention of the movable type press is to recognize that movable type utilized individual and (re)combinable letters to form new identity alliances and did not attempt to expose or extract hidden resemblances as found in mimetically associated marks. This was an important shift in the way identity formed across symbols, and it created a stronger link between the signifier and signified. In fact, given that, for encryption, identity forms in a pre-symbolic, entropic realm (as realized by Kittler's articulation of the notational epoch, discussed above), this indexical relationship is really a pre-symbolic selection of marks from a greater totality.

Whereas mimetic expression works on the level of how things do and do not look alike, notation works by dividing things into neatly-defined boxes, that is, by creating artificial identities or "tokens" of "types." These artificial identities can then be referenced by other notational marks, and so on. For encryption and decryption, the indexical reference, tying notation to notation, works without ambiguity or semantic "slack," which is why encryption can "losslessly" return to the original message through decryption. This is an important criterion for cryptography, since if any ambiguity were to be introduced during encryption or decryption, the very *idea* of cryptography would be vacated, and instead we would be dealing with guesswork, or at best, cryptanalysis.

Combination

The invention of letters and the printing press suggested a new combinatory way of thinking. That is, the novelty of printing from movable type drew attention to the combinatory logic inherent to the alphabet.[61] For natural language, the alphabet (and the associated sounds) serves as a potential storehouse for expression (constituting an evolving dictionary of permissible letter formations), which, through the agency of linguistic actors, is able to build meaningful words from meaningless parts. The movable type press, however (as I described above), enacts the modular replacement of one letter for another, which is to enact the

explicit combination of letterforms. In cryptography, ciphertext draws on an even greater storehouse than language or the material letterforms of the movable type press.

The key feature of the cipher wheel is to create greater complexity than can be understood by linguistic actors, an action or performance that draws on new "alphabets" with each turn of the wheel. As each new "alphabet" is introduced, the combinatory "space" is increased, and the indexed letter references another from an ever-greater and deeper storehouse. This is precisely the reason methodological cryptanalysis of polyalphabetic encryption takes so long—the size of the storehouse is not limited to a possible dictionary or the jobbing tray of the typesetter—but instead draws on the totality of combination of the introduced alphabets.

In fact, this kind of combinatorial thinking or investigating became a practical, scientific method. One of the more famous examples comes from Leibniz, who, in his *Dissertatio,* developed a method for investigating new relationships called "*ars combinatorial*."[62] In this early work, Leibniz suggested that by combining letters and interrogating their resulting configurations, which he called "complexions," one could explore all aspects of reality, in ways quite similar to Lull's *Art* from several centuries prior. Each complexion could be organized into a table or run through a calculating mechanism (resembling cryptographic apparatuses), so as to compare identities that might reveal orders and proximate relationships.

Mimesis in an Emerging Notational Epoch

Alberti never saw his role in history so clearly. Retrospectively, Alberti's contribution looks like a form of writing and a method of analysis, which in some ways anticipated later developments in computation. Nor did many of Alberti's contemporaries and followers see their role in the development of a notational epoch very clearly either. Many cryptographers turned to mimetic techniques and theories of representation while simultaneously developing systems of notational representation.

Alberti himself used and developed mimetic theories in his descriptions of painting and the plastic arts. In *De pictura*, he claimed that the artist's goal was to create a kind of illusion so powerful that, for example, even centuries later a portrait would possess powers of resemblance sufficient to cause a viewer's heart to palpitate.[63] Similarly, the cryptographer Johannes Trithemius (1462–1516) often turned to the hidden powers of resemblances when developing his cryptographic communication systems. Trithemius developed a system of "sympathetic" pin pricks for distant communication, relying on the powers of hidden resemblance.[64] Likewise, while Trithemius' *Polygraphia* (1518) included an apparatus similar to Alberti's cipher wheel, his earlier *Steganographia* (posthumously published in 1606) recommended the use of crudely drawn images, resembling spirits, to facilitate instant and secret communication. Despite also

being an accomplished cryptographer, Athanasius Kircher also believed that Egyptian hieroglyphs *visually* depicted inner truths about the world, through a hidden resemblance of the hieroglyphic symbols.[65] Or, finally, consider the ways that Bacon turned to mimetic powers. Despite the thoroughly notational nature of his "bi-literal" cipher, which analyzed the natural world in terms of binary notation, he also believed that the purity of the Chinese language, critical for his development of a "Real Character,"[66] was only possible because of an isomorphic link between their oral expression and hidden aspects of nature.

There is, in fact, no necessary reason to exclude mimetic characteristics from notational marks. Sometimes, the apparent powers of the alphabet, as they were put to work through the movable type press and cryptographic machines, were also fetishized and explored in their literal form. Such interests doubled back toward mimesis, as a kind of *typographic* mimeticism. For example, Francis Mercury van Helmont (1614–*c.* 1698–1699) thought that Hebrew letters depicted a literal homomorphism between the letterform and the speech organs. Indeed, Umberto Eco calls van Helmont's theory "a radical version of the mimological [mimetic] theory."[67] Spoken words derived from their letterform, according to van Helmont, *because* of the letter's visual similarity to speech organs in the mouth.

The movable type press, however, is just a mechanism for organizing letters on a printed page, and letters have been around for more than three millennia. By extension, Alberti's cipher wheel and its cryptographic decedents also just organize letters on the page, but in a more complex and thorough way. I argue that the historical novelty—the big invention of the movable type press and the cipher wheel—lay in the development and deployment of the notational logics, the reproducible, modular, indexical, and combinatory forms of representation.

The notational epoch, as it gained currency following Alberti's pioneering work in architecture and cryptography alike, also continued to develop. Following other cryptographers, and figures such as Leibniz and Boole, notation was increasingly operationalized and instrumentalized. By the twentieth century, the last vestiges of occult resemblances had finally been instrumentalized. Any serious study of cryptography came to accept that the field was no longer problematically mysterious.

The last moment in history when it was possible to seriously question whether cryptography operated on illusions and resemblances came to an end in the twentieth century. In 1945, Claude Shannon developed the "Mathematical Theory of Communication" that excluded, *de jure*, all hidden meanings of transmitted symbols.[68] However, Shannon's work on his purely syntactic theorems and measurements of communication were first developed during his study of cryptography during the Second World War.[69] With this last example, cryptography again had a pivotal role in the development of modern computing and information communication.

Notes

1 *De componendis cifris* was written in 1466 and remained in manuscript form during Alberti's life. A modern English translation by Kim Williams is available in Kim Williams, Lionel March, and Stephen R. Wassell, *The Mathematical Works of Leon Battista Alberti* (Basel: Springer Basel 2010). Reference will be made to this edition, using modern page numbers and section divisions. The modern Latin version has been published in Aloys Meister, *Die Geheimschrift Im Dienste Der Päpstlichen Kurie von Ihren Anfängen Bis Zum Ende Des XVI Jahrhunderts* (Paderborn: F. Schöningh, 1906).

2 Giovanni Battista Alberti, "De Componendis Cifris," in *The Mathematical Works of Leon Battista Alberti*, ed. Kim Williams, Lionel March, and Stephen R. Wassell (Basel: Springer Basel, 2010), 170. It seems Alberti was aware of Gutenberg's work as well as Arnold Pannartz and Konrad Sweinheim's (who introduced Roman typefaces); see March's commentary in Williams, March, and Wassell, *Mathematical Works*, 189.

3 Mario Carpo, *Architecture in the Age of Printing: Orality, Writing, Typography, and Printed Images in the History of Architectural Theory* (Cambridge: MIT Press, 2001).

4 Anthony Grafton, *Leon Battista Alberti: Master Builder of the Italian Renaissance* (Cambridge: Harvard University Press, 2000), 331. Williams defers to Grafton to make this point; however, Grafton never actually claims that the reference in *De cifris* was to seek sponsorship for publication. Rather, Grafton claims that Alberti's dedication to G.A. Bussi, in *De statua*, was a request for Bussi, as editorial advisor to Pannartz and Sweinheim, to seek publication of *De statua*.

5 David Kahn, *The Codebreakers: The Story of Secret Writing* (New York: Macmillan, 1967).

6 This conception of "notation" is drawn from Nelson Goodman's theory of notation, as described in his *Languages of Art* (1976). Nelson Goodman, *Languages of Art: An Approach to a Theory of Symbols* (Indianapolis, IN: Hackett Publishing, 1976).

7 In the context of mathematics, Stephen Wolfram has described this dearth of research, noting that Florian Cajori's *A History of Mathematical Notation* is one of the few histories of notation. Outside of mathematics (and to a very small degree, chemical notation), the importance of notation has not even yet been realized. Stephen Wolfram, "Mathematical Notation: Past and Future" (paper, *MathML and Math on the Web International Conference*, Urbana-Champaign, IL, 2000). Florian Cajori, *A History of Mathematical Notations* (London: The Open Court Company, 1928).

8 Friedrich Kittler, *Discourse Networks 1800/1900* (Stanford, CA: Stanford University Press, 1990), 369.

9 Ibid., xii.

10 Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences* (New York: Routledge, 2002).

11 C.f., Jacques Derrida, *Of Grammatology*, trans. Gayatri Chakravorty Spivak (Baltimore, MA and London: The Johns Hopkins University Press, 1998).

12 Walter Ong, *Orality and Literacy: The Technologizing of the Word* (New York: Routledge, 2002), 22.

13 Ong offers an extensive list of the psychodynamics of expression in an oral culture; see Ibid., 36 ff.

14 Plato, *Republic*, 394c; John M. Cooper and D.S. Hutchinson, eds. *Plato, Complete Works*. Indianapolis, IN: Hackett Publishing, 1997.

15 Ibid., *Republic*, 393d, 394d.
16 Ibid., 597ff.
17 Ibid., 596e.
18 Ibid., 596d.
19 Stephen Halliwell, *Aristotle's Poetics* (London: Duckworth, 1998).
20 Ibid., 5.
21 Foucault, *Order*, 19.
22 A translation of some of Lull's work, including the *Ars Brevis* (one of his major works that was revised many times over many years), is available in Ramón Llull, *Doctor Illuminatus*. Ramón Llull, *Doctor Illuminatus: A Ramón Llull Reader,* ed. Anthony Bonner (Princeton, NJ: Princeton University Press, 1993).
23 Lull's *Art* was modelled after the Trinitarian Godhead: *intellectus*, an art of knowing and finding Truth; *voluntus*, an art of training the will towards loving Truth; and *memoria*, an art of memory for remembering Truth.
24 There are several figures to Lull's art, and they developed during his prolific career. In the *Ars Brevis* the first, second, and fourth figures are circular, while others use a tabular format.
25 Llull, *Doctor Illuminatus*, 301.
26 The historical connection between Lull and Alberti was first made by Kahn, however, he admits that there is no causal proof of the connection. He notes that the "resemblance of this device [Lull's First Figure] to Alberti's disk is striking." David Kahn, "On the Origin of Polyalphabetic Substitution," *Isis* 71, no. 1 (1980): 125.
27 Reconstruction by author, modelled after the copy of *Ars Brevis* held in the Biblioteca El Escorial, Madrid Ms. f.IV.12 folio 3r.
28 The insight of recent cryptographers to call the origin and/or result of cryptography "plaintext" is a useful distinction, as it highlights the ways that mere "text" is different from "plaintext," even if the set of marks are identical.
29 Peter Pesic, *Labyrinth: A Search for the Hidden Meaning of Science* (Cambridge: MIT Press, 2000).
30 Francis Bacon, "Translation of the 'De Augmentis,'" in *The Works of Francis Bacon*, ed. James Spedding, Roberts L. Ellis, and Douglas D. Heath (Boston,MA: Houghton, Mifflin and Company, 1900), 117.
31 Carpo, *Architecture*, 120.
32 Kahn, however, does not believe that Alberti's *Descriptio Urbis Romae* device has any historical connection to the cipher wheel (Kahn, "On the Origin of Polyalphabetic Substitution").
33 Reconstruction by Bruno Queysanne and Patrick Thépot. Image used with permission of Patrick Thépot.
34 Carpo, *Architecture*, 123.
35 Ibid., 122. Carpo notes that "the key piece of hardware in Alberti's *De statua* was a revolving instrument, a wheel of sorts, in this case somehow inconveniently nailed to the head of the body to be scanned." Mario Carpo, *The Alphabet and the Algorithm* (Cambridge: MIT Press, 2011), 55.
36 "*domicilia*" (xii) (Alberti, "De Componendis Cifris," 180). Note that, like Lull's Art, Alberti uses terminology explicitly drawn from the tradition of the memory arts, calling his indexes "houses," which are *loci* for the memory.
37 Alberti, "De Componendis Cifris," 181, xiv.
38 Ibid., 179. "Itaque aut usitate littera uti est .a. aliam quampiam significabit, ut puta .g. et littera .b." in Meister, *Die Geheimschrift*, 134.

39 Alberti, "De componendis cifris." Image licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license (Buonafalce, https://commons.wikimedia.org/wiki/File:Alberti_cipher_disk.JPG).
40 See Goodman, *Languages*, 127 ff.
41 Alberti, "De Componendis Cifris," 181.
42 The term "scrambled," in English, is a common descriptor of encryption, but it is quite misleading as it suggests a destructive operation. See Quinn DuPont, "Cracking the Agrippa Code: Creativity without Destruction," *Scholarly and Research Communication* 4, no. 13 (2013): 1–8.
43 Meister, *Die Geheimschrift*, iv.
44 Ibid., iv.
45 See Alberti, "De Componendis Cifris," 173–178.
46 Ibid., 179, xi. Della Porta also discussed the "dislocations of the natural order of letters," see Wayne Shumaker, *Renaissance Curiosa: John Dee's Conversations with Angels, Girolamo Cardano's Horoscope of Christ, Johannes Trithemius and Cryptography, George Dalgarno's University Language* (Binghamton, NY: Center for Medieval & Early Renaissance Studies, 1982), 116.
47 Carpo, *Architecture*, 29.
48 However, since ciphertext has the appearance of a meaningless jumble of letters, the chance of copying error is also quite high.
49 Alberti, "De Componendis Cifris," 180, xii.
50 Carpo, *Alphabet*.
51 These logics were also apparent in later cryptography manuals. See Katherine Ellison's analysis of John Falconer's combinatory logic, where she argues that many of these functional aspects originally inhered in the alphabet. Katherine Ellison, "'1144000727777607680000 Wayes': Early Modern Cryptography as Fashionable Reading," *Journal of the Northern Renaissance* 6 (2014): para. 27.
52 The same problem plagued Francesco di Giorgio in the fifteenth century, whose technical drawings of hoisting cranes became so corrupt that, a century later, due to the omission of key elements (such as a working block-and-tackle system), his inventions were for all practical purposes lost. It may have been the case that some errors could be "fixed" on interpretation by a master builder already familiar with the working principles, but for those truly novel designs such errors would prove ruinous. See Thomas Misa, *Leonardo to the Internet: Technology & Culture from the Renaissance to the Present* (Baltimore, MD: The Johns Hopkins University Press, 2004), 27.
53 Carpo, *Architecture*, 18; Elizabeth Eisenstein, *The Printing Press as an Agent of Change* (Cambridge: Cambridge University Press, 1980), 47.
54 Writing numerals in longhand has the advantage of linguistic redundancy. See Carpo, *Architecture*, 119.
55 Eisenstein, *Printing Press*, 53.
56 Claude Shannon, "Communication Theory of Secrecy Systems," *Bell System Technical Journal* 28, no. 4 (1949): 656–715.
57 See also Shumaker, who argues that "Copyists—and typesetters—who must toilsomely reproduce long stretches of letters that make no sense to them are peculiarly liable to error." Shumaker, *Renaissance Curiosa*, 100.
58 Roy Harris, *The Origin of Writing* (London: Duckworth, 1986), 7 (emphasis added). For a similar idea, called "decontextualization" see Mary M. Slaughter, *Universal Languages and Scientific Taxonomy in the Seventeenth Century* (Cambridge: Cambridge University Press, 2010).
59 Ibid., 116.
60 Carpo, *The Alphabet and the Algorithm*, 28.

61 See Carpo, *Architecture in the Age of Printing*, 54.
62 Gottfried Wilhelm Leibniz, *Dissertatio de Arte Combinatoria*. An English translation is available in Leibniz, "Dissertation on the Art of Combinations." Like Alberti, Leibniz was also inspired by Lull's early combinatory explorations.
63 Alberti and Rocco Sinisgalli, *Leon Battista Alberti*, 74–75.
64 Shumaker, *Renaissance Curiosa*, 108.
65 Daniel Stolzenberg, ed., *The Great Art of Knowing: The Baroque Encyclopedia of Athanasius Kircher* (Florence: Stanford University Libraries, 2001).
66 Bacon, *The Two Bookes of Sr. Francis Bacon. Of the Proficience and Aduancement of Learning, Divine and Hvmane*; Bacon, *Of the Advancement and Proficiencie of Learning*.
67 Umberto Eco, *The Search for the Perfect Language*, trans. James Fentress (Cambridge, MA: Blackwell, 1995), 83.
68 Shannon and Warren Weaver, "A Mathematical Theory of Communication." Cf. Shannon, "A Mathematical Theory of Cryptography."
69 Fred W. Ellersick, "A Conversation with Claude Shannon." *IEEE Communications Magazine* 22, no. 5 (1984): 123–126.

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6 "That You Are Both Decipher'd"

Revealing Espionage and Staging Written Evidence in Early Modern England

Lisa M. Barksdale-Shaw

Introduction

> Neither is it a small matter these *Cypher-Characters* have, and may performe: For by this *Art* a way is opened, whereby a man may expresse and signifie the intentions of his minde, at any distance of place, by objects which may be presented to the eye, and accommodated to the eare: provided those objects be capable of a twofold difference onely; as by Bells, by Trumpets, by Lights and Torches, by the report of Muskets, and any instruments of like nature.
>
> —Sir Francis Bacon, *Of the Advancement of Learning*, Book VI, Chapter 1 (1605)[1]

The application of ciphers, or what the German Benedictine abbot Johann Trithemius called "steganographia" in 1499, emerged as vital to safeguard the growing English realm against the dangers presented by the anti-Protestant countries—Spain, France, and Italy.[2] Because of these political concerns, their use flourished during the Elizabethan era, but did not abound at the beginning of the Tudor dynasty. To illustrate, in 1522, Thomas Spinelly, ambassador to the Low Countries and Spain, died after having served both Henry VII and Henry VIII of England. During his thirteen-year tenure, he had written many letters, in cipher (i.e. code), with intelligence from Spain to the Kings of England. However, most problematically, Spinelly utilized the same cipher for his entire service whereas many subsequent intelligencers maintained ever-evolving ciphers.[3] At Spinelly's death, Henry VIII expressed his concerns about the danger of surveillance revealed in a letter to Sir Thomas Boleyn—whose daughter, Anne, would later become the king's second wife—and Doctor Richard Sampson, who would become the resident ambassador in Spain:

> Finally, forasmuch as the ciphers which sir Thomas Spynell (whose soule God pardon!) had, have come to the hands of sundry persons since his decease, soe that damage might ensue, by the disclosing of

> seacrets, unles a new ciphr were provided; therefore the kings highness, by the advice of his counsaile, hath not only conceyved and made such a cipher, but also sent the same, by his serveaunt, this bearer; who is purposely sent only for the sure deliverance of them to his said ambassadours; by which ciphers they may have knowledge in the contents of such articles as shall be written in ciphers to them at any time hereafter.[4]

After Spinelly's death, the ciphers, Henry VIII explained, were placed in the hands of many people—including the Emperor Charles V of Spain, his servants, and the messengers. Within his letter, Henry VIII communicated a well-founded fear. At this time, some letters contained both ciphered text and plain words, so the subject of the letters were easily deciphered. For instance, in an earlier letter to Henry VIII's father-in-law Ferdinand of Spain, Spanish ambassador Roderigo Gundisalvi de Puebla similarly intermingled the ciphered and the plain texts:

> The payment of the marriage portion is postponed till the Feast of the Archangel St. Michael [29 September]. With respect to CCCCXXIII (the marriage) of DCCCLXXVIII (the Queen of Castile) CCCCLXXXVIII (with) DCCCLXXXVII (the King of England), King Henry wishes to be informed when King Ferdinand will have returned to Castile in order to DCCCCLXXXIII (send) DCCCCLXXVIIII (an embassy).
>
> —London, 15th April 1507. MMCCCXXXI. (De Puebla).[5]

This comingling of cipher and plain text makes the nature of the letter quite transparent—even without a key to the coded text. In other letters, secretaries would fail to replace the symbol "V" (referring to Charles V of Spain).[6] For the Tudors, the use of ciphers began with Henry VII, but was expanded by Henry VIII.[7] However, it was during the reign of Elizabeth I of England that cryptography—"the art of secret writing in ciphers"[8]—significantly evolved as the chief device to create, transmit, and divulge intelligence. This essay argues that covert letters emerge as the crucial documents by which secrets are memorialized, deception is delivered, and treason is prosecuted.

Specifically, I submit that in early modern drama, the illicit letter develops as the central instrument through which the fates of the state's intelligencers, like John Webster's Bosola in *The Duchess of Malfi* (1613), Shakespeare's Aaron in *Titus Andronicus* (1594), and Christopher Marlowe's Friar in *The Massacre at Paris* (1593) and its secrets, become intertwined, and, in some instances, tragically fall, thereby illustrating how this written evidence functions to expose and disrupt communities and relationships. While the fates of the foregoing characters enthrall

the audience on the dramatic stage, some figures, like Sir Francis Walsingham, Thomas Phelippes, William Parry, and Thomas Morgan, maneuvered within lives filled with espionage—from secret meetings and conspicuous absences, to camouflaged communiques.[9] These men functioned in the "widest and most effective intelligence web."[10] Many of their letters, filled with ciphers and codes, materialize as dramatic staging within the courtrooms and the council rooms.

Within this analysis, I explore the nature of ciphered and coded letters, through their creation, their transmission, and their discovery—those which represent the state's interests and those which represent individual interests. As Aaron's "fatal-plotted scroll" (2.2.47) functions at the epicenter of the trial of Martius and Quintus, sons of Titus Andronicus, these coded letters likewise surround and serve as the impetus for several international incidents like the trial of Mary Queen of Scots. These moments of discovery and presentation of these cryptic letters influence how the state and its subjects view these sometime stealthy agents, their actions, and what, why, and who they surveil. At the same time, the history of these letters affects how the state and the courts view this written evidence and how such evidence will weigh against or for these agents. How can such proofs be adjudged as credible, authentic, and truthful when created, communicated, and kept in ways which contravene any such credibility, authenticity, or truth? How might the now deciphered letters relate to the eventual fates of these former spies and heads of state, like the public trial of Anthony Babington or even the death of Mary Queen of Scots herself?[11]

This paper further examines how documents that may appear to be merely letters are used as legal and political instruments to monitor the current condition of the sovereignty's power, the subject's individual rights, and to recalibrate the society's future course. Within my analysis, I focus on the attempts in the play to devalue the trustworthiness of written evidence, particularly letters, offered at a time when the early modern courts emphasized the reliability of such evidence, and demonstrate how interpersonal communications intervene as vital legal vehicles within this society.

My examination builds upon a broad array of scholarship on early modern letter writing in England. Recent scholarship examines the culture of writing, women writers, and the dramatization of writing in theatrical production. In a society that still struggled with the education of women, the documentation of women writers develops as distinct.[12] Gary Schneider suggests that it was deemed improper for women to publish personal letters.[13] He highlights, for example, James Daybell's study of women writing between 1540 and 1603 where "over half of the 2,300 letters were written by their own hands."[14] Detailing a letter from Thomas Overbury to Lord Rochester "under Seales," Overbury stressed the importance of the missive as he addressed the poetry scandal by simply concluding: "I vowd to have wrote the Truthe."[15] His emphasis on the production and the portrayal of truth suggests an ideological framework at once ethical, legal, and political.

Notably, the critical work analyzes the nature of clandestine affairs, secret communication, and documentary evidence during this period. Catherine Fletcher offers a wonderful insight into the role of the ambassador as a site for "the dissemination of half-truths and *disinformation*" and "the provision of *information*" as much as secret negotiations in her work, *Diplomacy in Renaissance Rome: The Rise of the Resident Ambassador* (2015).[16] Other scholars, like Constance Brown Kuriyama, investigate documentary evidence, such as Thomas Drury's cryptic letter to mine its secrets. Specifically, Drury's letter arises as curious because of the information that it fails to mention, like Marlowe himself, or the important secrets on recently reported libels in the city of London, as discussed in Kuriyama's *Christopher Marlowe: A Life* (2002).[17] In particular, Alan Stewart examines the letters, which surround the ambassadorship of Sir Amias Paulet from 1576 to 1579, as an instruction on the nature of intelligence-gathering.[18] These scholars provide fruitful ways of intervening with letters during this era.

For this study, I maintain that the letter serves as the focal point not only within drama, but also within early modern society, as the lives of these intelligencers become inextricably attached to the documents that they create, handle, transport, and present. Using primary texts, I examine these ciphers for truth-telling opportunities, but also the creation and the compilation of the narratives, which advance politics and culture and safeguard this society. Furthermore, this analysis fosters the ability to investigate both the documents and the state-actors, around which these documents circulate. In spite of the early modern prohibitions against women's letter-writing, this essay also demonstrates how Mary Queen of Scots's prolific letter-writing develops as the seat of the production, the distribution, and the presentation of secret letters and ciphers.

St. Bartholomew's Massacre

The treasonous letter, during this early modern era, served as the key document by which the futures of state spies and its secrets became interwoven, with fatal consequences, thereby underscoring how written evidence betrayed and destroyed communities and relationships. To demonstrate, in *The Massacre at Paris* (1588–1592), Christopher Marlowe uses the letter to communicate secret intelligence, forecast danger, and implicate illegality, which not only fells the people of France—Catholic and Protestant—but also its aristocracy and heads of state, like the Duke of Guise and the King Henry III of France, respectively.[19] Within this dramatized portrayal of St. Bartholomew's Massacre (1572), a bloody and violent anti-Protestant upheaval in Paris, a secret but false letter functions as the instrument of betrayal and destruction. At the end of the drama, the Friar, an assassin, enters as a part of a conspiracy to avenge Guise's death, and advance the Catholic cause against Protestantism.[20]

For the Friar, vengeance comes in the form of a letter—the key to revealing the nature of espionage in this important political and religious moment in France. At Scene 22, this Jesuit friar uses a cryptic letter as a subterfuge to complete an assassination of the French King, Henry III, who trusts that "our Friars are holy men, / And will not offer violence to their King, / For all the wealth and treasure of the world" (22.23–25). Ironically, during this war of religion, holy men, like the Friar, function not as the architects, but certainly—using "what news [they] bring" (22.28)—as the instruments of violence. Eerily, the stage direction reads: *"He stabs the King with a knife as he readeth the letter, and the King getteth the knife and kills him"* (22.33, *italics original*). While France contended with the bloody French Wars of Religion (1562–1598), England hunted for English priests, trained in Rome and spreading treasonous dissension and derision throughout the Tudor realm to maintain a strong Catholic presence—in anticipation of a Spanish and French coup to supplant Queen Mary Stuart on the British throne.[21] The Scottish queen served as a centerpiece in this political intrigue filled with as many deadly secrets as dead bodies. Incarcerated in England for the alleged murder of her second husband Henry Stuart, Lord Darnley, Mary displayed a political mastery of her own; she wielded a skillful acumen, as she played the desperately tragic figure to Elizabeth I, her cousin, and a cunning cryptologist to her ever-growing supporters.[22] Ironically, the very ciphers that she created to cloak her private schemes exposed this illegal activity in a highly public fashion.

The Babington Plot

An indomitable force against these treasonous contrivances, Thomas Phelippes, (1556–1626), a gifted linguist, mathematician and cryptographer, was a trusted source of intelligence for Sir Francis Walsingham in secret matters (Alford xvii).[23] Although he eventually discovered, acquired, and presented these fatalistic documents to the public, Phelippes routinely intercepted letters from diverse persons (998).[24] For instance, he interrupted many letters, in particular missives from Mary Queen of Scots to the French Ambassador de Chateauneuf on July 14, 1586, Thomas Morgan to Mary Queen of Scots on July 16, 1586, and most famously Mary Queen of Scots to Anthony Babington on July 17, 1586, a missive, which is discussed here.[25] Although Mary's spies hid the cipher in a barrel stopper,[26] Phelippes discovered the document. With this cipher, he uncovered a treasonous design to assassinate Queen Elizabeth I by forging Mary's handwriting with the following language in the Scottish queen's July 17 letter to Babington:

> I w be glad to know the names and quelityes of the sixe gentlemen which are to accomplish the dessignement, for that it may be I shall

> be able uppon knowledge of the parties to give you some further advise necessarye to be followed therein..... as also from time to time particularlye how you proceede and as [soon][27] as you may for the same purpose who bee alredye and how farr every one privye hereunto.

This additional language not only implicates both Mary Queen of Scots and Anthony Babington, but it also reveals an extensive conspiracy, including six named men: Gilbert Gifford, "a trusted courier," Thomas Morgan, a cipher clerk to Mary Queen of Scots, John Ballard, a Catholic priest, Charles Paget, a secretary to the Scottish queen, Gilbert Curle, a cipher secretary from Scotland, and Bernardino de Mendoza, the Spanish ambassador to London (1578–1584).[28] This solitary piece of evidence, ensnaring multiple conspirators, evolved into the centerpiece during multiple high-profile treason cases, specifically the trials of Anthony Babington and Mary Queen of Scots.

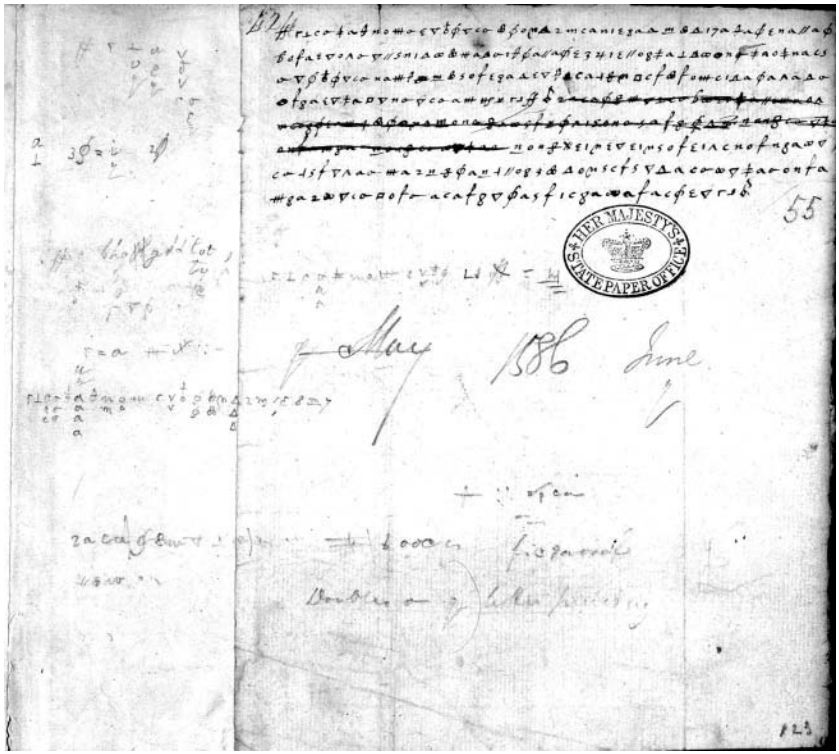

Figure 6.1 Mary Queen of Scot's cipher, SP 53/18/55. The National Archives, Kew, September 1, 1586.

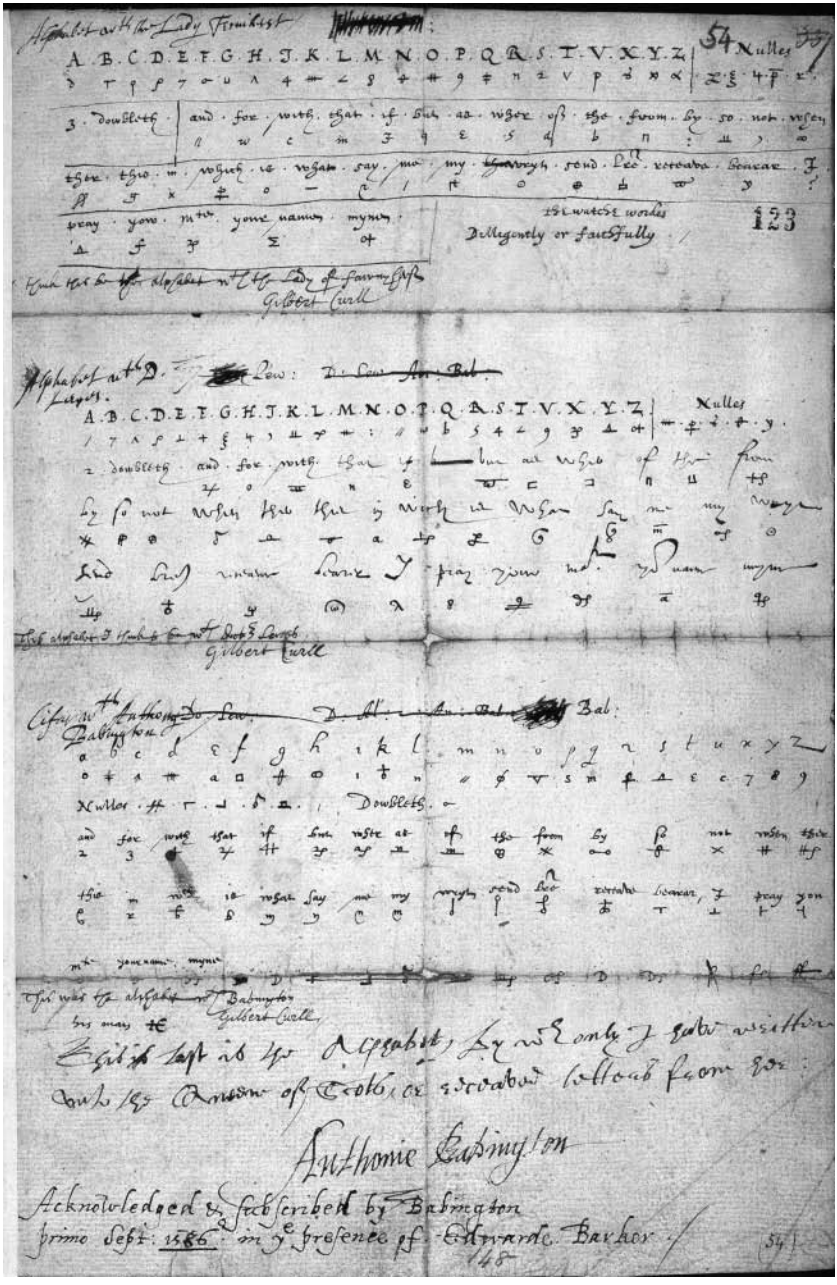

Figure 6.2 Anthony Babington's postscript, SP 12/193/54. The National Archives, Kew, September 1, 1586.

This image, the Babington postscript and cipher, contains seven lines of symbols, not including those which have been struck by a line. In multiple places, the document has scrawls with Babington and Gilbert Curle's name. Curle, Scottish, was the cipher secretary to Mary Queen of Scots. Apparently, as a part of his confession, Babington "acknowledged and subscribed" to the information in the enciphered letter "in the presence of Edward Barker," a notary public, on September 1, 1586.

On August 14, 1586, Anthony Babington was arrested and taken to the Tower of London the next day.[29] He, along with twelve co-conspirators were charged with high treason, alleging their complicity with the Spanish to invade England, assassinate Elizabeth I, and enthrone the Scottish queen.[30] On September 1, Babington was presented with the cipher that he had used in his letter to Mary Queen of Scots and with an opportunity by Walsingham to confess to his unlawful conspiracy. In spite of giving full confessions, they were tried in two groups between September 13 and 15, 1586.[31] Moving from the Privy Council room to the courtroom, the key piece of evidence to prove these allegations materializes as the Babington letter, which was exposed by Phelippes's manipulation, with a forged postscript. On the strength of Babington's letter, the court proved that the co-conspirators intended: "(1) The destruction of the Queen's majesty's person. (2) The invading of the realm with foreign forces and stirring aid at home to assist them. (3) The preservation and delivery of the Queen of Scots and advancing her to the crown of England."[32] Ultimately, Babington was publicly executed on September 20, 1586, near the church of St. Giles-in-the-Fields, where one of the co-conspirators, John Savage, initially developed the murder conspiracy. While the evidence was overwhelming, some sources suggest that a few witnesses lacked credibility.[33] The highly-publicized trials resulted in guilty verdicts, and at their executions, the bodies of these traitors were torn asunder, as instructed by Queen Elizabeth.[34]

This public spectacle hearkens to William Shakespeare's play *Titus Andronicus* (1594).[35] While written within a few years of the Babington executions, the drama, which is set in Rome after years of war, descends into a protracted display of post-war violence between the Andronici and the Goths on the eve of the newly elected emperor, Saturninus. Unlike the Babington Plot, this trial centers upon a written, but false and anonymous letter, discovered beneath an elder tree, and wrongfully incriminates Titus's sons, Martius and Quintus, for murder—this written evidence is manufactured, planted, and presented by the Goths and their slave, Aaron the Moor. In spite of the manipulated evidence, Saturninus finds the defendants guilty. As much as the trial was a travesty, the emperor's legal judgment—perhaps altered like Queen Elizabeth's by a desire for "royal justice"[36]—yields to a desire to "devise / Some never-heard-of torturing pain for them" (2.2.284–285). For both the play and the Babington Plot, the concerted effort to camouflage the truth

fails—"but in the end truth will out," as Shakespeare notes in *The Merchant of Venice* (2.2.77).[37] For Mary Queen of Scots's trial, there arose a similar demand for justice.

Later in October 1586, in spite of her protests, the Scottish queen's trial was held.[38] During the trial, along with the evidence of Babington's letter, the state offered the testimonies of two co-conspirators, Thomas Morgan and Gilbert Curle, who admitted to writing treasonous letters on her behalf. Although Babington sent Mary Queen of Scots the letter, it took her almost ten days to respond.[39] Despite the delay, her written response secured the judgment against this fallen queen, Mary.

Early Modern Shadow Men

The early modern intelligencer investigated the nature of ciphered and coded letters in spite of the writer's intention—for these documents influence both local and global governance of the country. These secret devices influenced what, why, and whom they surveil. In Webster's *The Duchess of Malfi*, Daniel de Bosola plays such a role, as he manages the volume of letters under his purview in this tragedy about a duchess who suffers at the hands of her brothers after she marries Antonio, a steward, who is beneath her aristocratic station. While seeming to function at the periphery, Bosola the ex-con—now in the employ of those who were responsible for the crimes—sits at its epicenter. Not unlike Marlowe's Friar and Shakespeare's Aaron the Moor, Bosola emerges as a capable intelligencer whose skills have not been overlooked by Ferdinand and the Cardinal. Still, unlike the Friar and Aaron, Bosola has served the Cardinal previously: when this intelligencer accepts employment with these brothers, he knows what his dark duties will entail. In the play, Webster exhibits letters, which are either found or delivered by their agent of secrets, Bosola, both at 2.3 and 3.5. Here, I address the former scene. This playwright offers the audience a staging of the reading of these letters as well. At 2.3, Bosola reads in soliloquy a letter dropped by Antonio:

> *The duchess was delivered of a son, 'tween the hours twelve and one, in the night: Anno Dom. 1504,—, this year-decimo nono Decembris,*—that's this night—*taken according to the meridian of Malfi*—that's our duchess: happy discovery!-*The lord of the first house, being combust in the ascendant, signifies short life: and Mars being in a human sign, joined to the tail of the Dragon, in the eighth house, doth threaten a violent death; caetera non scrutantur.*
> (2.3.56–64)[40]

The presentation of this letter on the stage before the audience is conspicuous both dramatically and technically. Webster clears the stage where

the audience's attention becomes drawn to one solitary figure holding a "found letter." This "parcel of intelligency" (2.3.67)[41] contains secret information that Bosola, this paid informant, must decide whether he will deliver to his masters, which might threaten the lives of the duchess, her Antonio, and the newborn babe. He discovers, transports, and deciphers these documents—eventually determining their significance. In many ways, Antonio's service to his masters parallels the early modern intelligencers—some of whom were paid informants, and a chosen few were masters at steganographia. In the end, these agents amass an archive of secret texts.

John Somers, Cryptologist

Although it contributes enormously to the collection of steganographia, John Somers's work is rarely discussed. Somers, a cryptologist, served as a secretary under Francis Walsingham; by 1578, Thomas Phelippes's tenure began with Walsingham, and would later lead to the ultimate exposure of the Babington Plot.[42] Encompassing more influence than a historic legal case, Somers embodied a figure whose work extends beyond his service to the Principal Secretary to Queen Elizabeth I of England. By examining the surveillance prior to 1578, we might surmise the nature of Somers's employment. For example, in February 1570, Walsingham was dispatched on a diplomatic mission to France, and later in August, appointed as ambassador to France. Almost a year later, Thomas Howard, the Duke of Norfolk's conspiracies with Mary Queen of Scots, the stratagem to marry and overthrow the English crown, were discovered—after which he was arrested, released, and eventually convicted of treason. This historic scheme thwarted these threats to both the crown and the Protestant faith.[43]

Beyond the Norfolk treasonous affair, Somers's role in the business of political intrigue was significant if judged merely by the volumes of ciphers that he gathered in the State Papers. His expertise lay in deciphering many letters, relating to Scotland, during this period for intelligence-gathering. While some of these ciphers were extensive, others were brief and seemingly without much information. They reveal interesting contrasts to the Scottish queen's earlier Babington cipher. Notably, this abbreviated cipher, "dated from 27 April 1574," contains a brief message, which is included with the transcription of the cipher:

> Alphabeth betwene one fled into the Low Countrees, naming himself and his brother J. Carr directed to his sister Dorothy Carr from St. Davids in Wales 27 April 1574.[44]

In terms of surveillance, this message becomes important when we consider the multiple rebellions, which occurred in the Low Countries, most

lately in April 1572.[45] The Dutch revolt flourished against the government for alleged abuses stemming from Spanish rule, the Inquisition, arbitrary governance, and extortion.[46] On April 1, 1572, William Luney and the Sea Beggars—Protestant Dutch nobles opposing Spanish rule—captured the port of Brill, instigating revolts in Zeeland, Friesland, and Holland. Barely five days later, in nearby Flushing, another uprising supporting Prince William of Orange occurred on the island of Walcheren where French and Walloon soldiers were garrisoned.[47] Because these rebellions continued to occur, Walsingham might have kept "watchers" (i.e. spies) alert to any potential illegal activity arising from these Dutch revolts.[48] Quite possibly, this cipher provided a lead to a key actor in the uprisings, which had been escalating in this area. Of note, the latter part of the transcribed text implies that some of these players, specifically the sister Dorothy, were located in Wales—instead of with the Carr brothers. It is unclear, because of the cipher's brevity, whether the sister was a part of the conspiracy that Somers was investigating. Unlike the Babington cipher, this coded letter leaves much unanswered, for there are no extensive annotations, suggesting a trial or any other proceeding that would connect this cipher to grander schemes.

In this same year 1574, Somers deciphered another letter, but this time it is about Scotland.[49] The letter notes neither the specific month nor day, so it becomes unclear whether the letter was created before or after the April 1574 cipher. However, the contents of the letter provide some clues. First, the year suggests several facts about Walsingham—having been recalled, he was no longer in France; second, as of December 1573, he was named Principal Secretary and Privy Councilor.[50] For a time, Walsingham was, observes Katharine Maus, "the successfully unseen spectator, the terrifying Gyges [of Lydia] who turns his secret knowledge to worldly gain."[51] By the time Walsingham received letters on June 3, 1574 about the assassination of King Charles IX of France, the spymaster was not in France.[52] While he was no longer there, Walsingham was still surveilling the French, the Spanish, and especially Mary Queen of Scots.

Along with the year, the letter contains one line of writing: "Alphabeth betwene she said french amis Mons. de La Mothe and she said vera." The rest of the document includes what appears to be the cipher key, so rather than the entire encrypted text, Somers provided the transcribed text and a tool for future transcription.[53] This key comprises the symbols for different words and people—mostly in French. This cipher may have been one of many created by Mary Queen of Scots. Although French was not her father's tongue, it was definitely her mother's. In 1538, James V of Scotland had married Mary de Guise, a native of Lorraine. The French language became, as Alison Weir notes, "Mary's first language and would remain so for the rest of her life." She also learned Spanish, Italian, Latin, and Greek—while conversant in Scottish, Mary

was not proficient in writing it, and did not learn English until 1568.[54] In fact, the letter's reference to Monsieur de La Mothe Fenelon echoes the words of Mary to Elizabeth in one of her letters. In January 1574, she wrote:

> Has written to Monsieur de la Mothe entreating him to ascertain what she can suppress or amend in her letters which will render them worthy of some favourable reply. Hopes she will no more find her ear deaf to her entreaties. Sheffield. Signed: Marie R.[55]

This reference to Monsieur de la Mothe provides one argument for the earlier appearance of this deciphered letter by Somers having occurred after Mary's January 1574 letter. In several letters before the Babington Plot, Mary had complained to de la Mothe about Queen Elizabeth and her unwillingness to cede terms, especially releasing the Queen of Scots from bondage.[56]

In spite of her imprisonment, Mary was a clever statesman. Her prison letters emerge as prolific and nuanced. Pleading her case domestically and globally, she wrote often—not only to Queen Elizabeth, but to the Duke of Guise, Walsingham, and the French Ambassador. We must not forget the letters to Babington, and other conspirators, which ultimately resulted in her execution. This deciphered letter demonstrates that while she pleaded the poverty of her cause to Elizabeth, she also had several other schemes in progress with persons connected to France, Spain, and Scotland.

Conclusion

Filled with many devious cloaks and some deadly daggers, the early modern world of intelligence evolved, swiftly, by necessity. Starting with Henry VII of England, the application of ciphers began as infrequent and haphazard. By the time Henry VIII took the throne, the use of ciphers had become consistent in the transmittal of state affairs. As in other matters during this Golden Age, Queen Elizabeth I and her secretaries, Burghley and Walsingham, took the use of intelligence agents, complicated ciphers, and stealthy communication to a level that built upon the science begun with the Greeks and the Romans.[57] By the end of the Tudor reign, the Stuarts continued to employ ciphers while uncovering conspiracies, like the Gunpowder Plot of 1605, an assassination attempt on James I of England, the son of Mary Queen of Scots.[58] In his last letter—dated April 3, 1606—to Anne Vaux, Henry Garnet, an English Jesuit priest and one of the plot's co-conspirators, denied his culpability in the treasonous alliance:

> It pleaseth God daily to multiply my crosses. I beseech him give me patience and perseverance *usque in finem*. I was, after a week's

> hiding, taken in a friend's house, where our confessions and secret conferences were heard, and my letters taken by some indiscretion abroad;—then the taking of yourself;-after, my arraignment;-then the taking of Mr. Greenwell;-then the slander of us both abroad;—then the ransacking anew of Erith and the other house;—then the execution of Mr. Hall;-and now, last of all, the apprehension of Richard and Robert; with a cipher, I know not of whose, laid to my charge, and that which was a singular oversight, a letter in cipher, together with the ciphers; which letter may bring many into question.
> Suffer etiam hos; audistis et finem Domini vi
> distis ; quemadmodum miserieors Dominus est et
> miserator. Sit momen Domini bemedictum.
> Your's, in aeternum, as I hope,
> H. G.[59]

Using ciphers to hide their bloody devices, co-conspirators, like Garnet, attempted to assassinate James I of England, usurp his throne, and supplant another—not unlike the attempts against Elizabeth. In this world of secret conveyances, activities, and men, it becomes extremely difficult to discern the truth. Yet, men like Sir Francis Walsingham, Robert Cecil, Earl of Salisbury, and Sir Francis Bacon immersed themselves in a world of deception, and expanded a field of intelligence beyond its humble beginnings with Henry VII. Within this culture of spying, we even see a family of spies—from the Walsinghams and the Cecils to the Throckmortons and the Bacons—evolve to contribute to this cloaked arena.[60] The safety of the crown rests, in large part, within enciphered letters, not merely breaking their codes, but also determining whether these documents are truthful, or "do beguile…by seeming otherwise" (Shakespeare, *Othello*, 2.1.122–123).[61]

Notes

1 Francis Bacon, *The Advancement of Learning* (Auckland: The Floating Press), 1605.
2 James Daybell discusses the history of steganographia in *The Material Letter in Early Modern England: Manuscript Letters and the Culture of Practices of Letter-Writing, 1512–1635* (New York: Palgrave Macmillan 2012), 152.
3 Garrett Mattingly, *Renaissance Diplomacy* (Baltimore, MD: Penguin Books, 1964), 4, 190–191. Spinelly, a Florentine, was similar to Eustace Chapuys, Spanish ambassador to England, who communicated with Charles V from 1529 to 1541 using the same cipher.
4 "Instructions given by the Kings Highness to his trusty and right welbeloved Counsailors Sir Thomas Bolayn, Treasurer of his Housholld and Doctor Sampson, Deane of his Chapell, contayninge such matters and overtures as on the Kings behalf they shall make to the Emperour," in John Galt, *The Life and Administration of Cardinal Wolsey* (London: T. Cadell and W. Davies, Strand, 1812), Appendix, lxxxv–xcvii.

5 Gustave A. Bergenroth, *Calendar of Letters, Despatches, and State Papers, Relating to Negotiations Between England Spain, Preserved in the Archives at Simancas and Elsewhere*, vol. 1 (London: Longman, Green, Longman and Roberts, London: Long, Green Long and Roberts, 1862), 410, original in Spanish.
6 Mattingly, *Renaissance Diplomat*, 190–191.
7 Peter Dawkins, *The Shakespeare Enigma* (London: Polair Publishing, 2004), 320.
8 Daybell, *The Material Letter in Early Modern England*, 152.
9 Stephen Alford. *The Watchers: A Secret History of the Reign of Elizabeth I* (New York: Bloomsbury Press, 2012), 18, 145, 193, 210, 366. William Parry also becomes one of a few intelligencers who later finds himself on trial in Alford, 141.
10 Derek Wilson. *Sir Francis Walsingham: A Courtier in an Age of Terror* (New York: Carroll and Graf, 2007), 166.
11 Howell, Thomas Jones and David Jardine. *A Complete Collection of State Trials and Proceedings for High Treason* (London: S.I., 1744), 251.
12 In his biography on Thomas More, Richard Marius notes that the sixteenth century is the first century since the classical age when there existed evidence of many educated women—including queens and female religious figures. See Richard Marius, *Thomas More: A Biography* (Cambridge, MA and London: Harvard University Press, 1999), 223.
13 Gary Schneider, *The Culture of Epistolarity: Vernacular Letters and Letter-Writing in Early Modern England, 1500–1700* (Newark: University of Delaware Press, 2005), 197.
14 Ibid., 293.
15 Ibid., 23.
16 Catherine Fletcher, *Diplomacy in Renaissance Rome: The Rise of the Resident Ambassador* (Cambridge and New York: Cambridge University Press, 2015), 113.
17 Constance Brown Kuriyama, *Christopher Marlowe: A Renaissance Life* (Ithaca, NY and London: Cornell University Press, 2002), 146–147.
18 Alan Stewart, "Francis Bacon's Bi-literal Cipher and the Materiality of Early Modern Diplomatic Writing," in *Diplomacy and Early Modern Culture*, ed. Robyn Adams and Rosanna Cox (Houndsmills: Palgrave Macmillan, 2011), 120–137, at 120–122.
19 Kuriyama suggests that the play was written between 1588 and 1592—the exact order of the composition of several of his plays are unknown, xvi. However, Frank Romany and Robert Lindsey surmise that the play was written in 1592, *The Complete Plays: Christopher Marlowe* (London and New York: Penguin Books, 2003), x. See the discussion of numerical, hieroglyphic codes and trade and business jargon to create both meaningful and meaningless code in Charles Nicholl, *The Reckoning: The Murder of Christopher Marlowe* (Chicago, IL: The University of Chicago Press, 1992), 105.
20 For further review of multiple assassination schemes and attempted machinations in France and England, particularly the murder of Henry III by a clergyman, see John Michael Archer, *Sovereignty and Intelligence: Spying and Court Culture in the English Renaissance* (Stanford, CA: Stanford University Press, 1993), 72, 91. See the discourse on both Marlowe's dramatic *The Massacre at Paris* and the historical St. Bartholomew's Massacre in Park Honan, *Christopher Marlowe: Poet and Spy* (Oxford and New York: Oxford University Press, 2005), 181, 272–276, 286.
21 While several sources suggest that the French Wars of Religion ended in 1598, Mark P. Holt maintains that the date is much later in his monograph,

The French Wars of Religion 1562–1629 (Cambridge and New York: Cambridge University Press, 2005).

22 The National Archives, Kew, possesses over 100 ciphers in its Secretaries of State: State Papers, Scotland Series I Collection—largely attributed to Mary Queen of Scots and her agents. See also Alison Weir, *Mary, Queen of Scots and the Murder of Lord Darnley* (New York: Random House, 2004) and John Cooper, *The Queen's Agent* (New York: Pegasus Books LLC, 2012).

23 Notably, Phelippes's fortunes fell severely after Walsingham's death in Alford, *The Watchers*, xvii.

24 Markham John Thorpe, *Calendar of State Papers: Scottish Series: Volume II* (London: Longman, Brown, Green, Longmans & Roberts, 1858), 998. For additional discussion of intercepted letters, see Alison Weir, *The Life of Elizabeth I* (New York: Ballatine Books, 2008), 345–346, Stephen Alford, *The Watchers*, 119, 145, 159, 173, 183, 198, 284, 287, 349, 360, 386, and John Digby Bristol, *Journal of Sir Francis Walsingham From December 1570 to April 1583*, vol. 104, 17.

25 See also Mary to Monsieur de Chateauneuf. [July 13.] C.P., vol. XVIII; Thomas Morgan to Mary. [July 16.] C.P., vol. XVIII; Mary to Anthony Babington. [July 17.] C.P., vol. XVIII. Elizabeth: July 1586 in *Calendar of State Papers, Scotland: Volume VIII, 1585–1586*. ed. William K. Boyd (London, 1914), 494–578. *British History Online*. Version 5. Institute of Historical Research. Web. 14 November 2016. Indeed, Thomas Morgan's letter to Mary is ciphered, but is deciphered by Phelippes.

26 Daybell, *The Material Letter in Early Modern England*, 170.

27 The original letter uses the word, "son," but I have inserted the word, "soon," in brackets for clarity.

28 Alford, *The Watchers*, 229. For discussion of the clandestine affairs of Charles Paget's brother, Thomas, see Alford, 167–169. In his play, *Measure for Measure* (1604), William Shakespeare introduces a character, named "Barnardine," who is described as a "dissolute prisoner" in his *Dramatis Personae*. William Shakespeare, *Measure for Measure*. ed. Jilius W. Lever, Arden Shakespeare (London: Thomson Learning, 2006).

29 Alford, 229.

30 Karen Cunningham, *Imaginary Betrayals: Subjectivity and the Discourses of Treason in Early Modern England* (Philadelphia: University of Pennsylvania Press, 2001), 21.

31 Alford, *The Watchers*, 234.

32 See the Examination of the Conspirators, [Sept. 6.], C.P., vol. XIX.

33 See John Hungerford Pollen, *Mary Queen of Scots and the Babington Plot*, Edited from the original documents in the Public Records Office, Yelverton MSS (Edinburgh: University Press by T. and A. Constable Ltd. for the Scottish History Society, 1922). Tyrrell testified although he was incarcerated at the time of the exchange of letters between Babington and the Scottish queen. However, this source suggests that Tyrrell's testimony was credible, in terms of co-conspirator Ballard's character.

34 Alford, *The Watchers*, 235.

35 The play was performed, according to Henslowe's receipts, for the first time on January 24, 1594, as noted in *William Shakespeare's Titus Andronicus*, ed. Jonathan Bate, Arden Shakespeare (London: Thomson Learning, 2002), 70. However, scholars suggest that the play was written in 1592, even closer in time to the events of the Babington trials. See also *The Norton Shakespeare*, ed. Stephen Greenblatt, Walter Cohen, Suzanne E. Howard, Jean E. Howard, and Katharine Eisaman Maus, Gordon McMullen (New York: W.W. Norton, 2016), 491.

36 Alford, *The Watchers*, 235.
37 William Shakespeare. *The Merchant of Venice*. ed. John Russell Brown, Arden Shakespeare (London: Thomson Learning, 2001).
38 At the time of her trial, Mary Queen of Scots was forty-three years old, and had spent almost two decades incarcerated. Ibid., 236.
39 Ibid., 214.
40 John Webster. *The Duchess of Malfi*. ed. John Russell Brown, The Revels Plays (Manchester: Manchester University Press, 1988).
41 See page 167 at note 67, where Leah Marcus explicates Webster's phrase, "parcel of intelligency," as "piece of covert information." *The Duchess of Malfi*. ed. Leah S. Marcus, Arden Early Modern Drama (London: Arden Shakespeare, 2009).
42 There are two brief observations about John Somers in Robert Hutchinson, *Elizabeth's Spymaster: Francis Walsingham and the Secret War That Saved England* (New York: Thomas Dunn Books St. Martin's Press, 2006), 34, 290.
43 Stephen Budiansky, *Her Majesty's Spymaster* (New York: Penguin, 2005), 219.
44 I noted that the word, or perhaps phrase—"Alphabeth"—appears in at least two ciphers. Later, I learned that "Aleph" and "Beth" are the first two letters in the Hebrew alphabet. Gregory Farr, "Greetings." Message to Lisa M. Barksdale-Shaw. 2 March 2017. I also noted that "alpha" and "beta" represent Greek alphabets. Hence, the word or phrase probably connotes a person whose name is enciphered as, "AB."
45 Budiansky, 219.
46 J.C.H. Blom and E. Lamberts, *History of the Low Countries* (New York: Berghahn Books 2006), 134.
47 Matthew Woodcock, *Thomas Churchyard: Pen, Sword, and Ego* (Oxford and New York: Oxford University Press, 2016), 150. See also discussion of letters from William of Orange to Walsingham on the taking of Middleburg in February 22, 1573 in John Digby Bristol, *Journal of Sir Francis Walsingham*, 17.
48 I take the term, "watchers," from Stephen Alford's monograph, *The Watchers: A Secret History of the Reign of Elizabeth I*.
49 Enciphered by John Somers, one of Walsingham's secretary, SP 53/23/2 The National Archives 1574.
50 Budiansky, *Her Majesty's Spymaster*, 219.
51 Katharine Eisamann Maus, *Inwardness and the Theater in the English Renaissance* (Chicago, IL: The University of Chicago Press, 1995), 46.
52 Bristol, *Journal of Sir Francis Walsingham*, 18.
53 Enciphered by John Somers, Walsingham cryptologist, SP 53/23/3, The National Archives, Kew, April 27, 1574.
54 Weir, *Mary Queen of Scots and the Murder of Lord Darnley*, 13–14.
55 1 p. Holograph. Addressed. Printed at length, Labanoff, Vol. III., 120. Elizabeth: January 1574', in *Calendar of State Papers, Scotland: Volume IV, 1571–74*, ed. William K Boyd (London, 1905), 636–640.
56 François A. Mignet, *The History of Mary, Queen of Scots* (London: Richard Bentley and Sons, 1887), 299–300.
57 Dawkins, *The Shakespeare Enigma*, 320.
58 For further discussion of the conspiracies against James I, see Charles Durston, *James I* (London and New York: Routledge, 1993), 9–10, 58–60.
59 David Jardine, *A Narrative of the Gunpowder Plot* (London: John Murray, 1857), 252.
60 While I have mentioned Francis and Anthony Bacon, Charles and Thomas Paget, Francis and Thomas Walsingham, I should also include Guldeford

Walsingham, Thomas's brother, who gathered military intelligence for his cousin (Kuriyama 98) to name a few families; in this sea of secrets, this list is by no means exhaustive. See also secret information and messages that circulated around Nicholas Throckmorton in Annabel Patterson, *The Trial of Nicholas Throckmorton* (Toronto, ON: Centre for Reformation and Renaissance Studies, 1993), 13–14, 30–31. For discussion on Anthony Bacon's intelligence work with ciphers under James I, see Du Maurier, Daphne. *Golden Lads: Sir Francis Bacon, Anthony Bacon and their Friends* (New York: Doubleday and Company, Inc., 1975).

61 William Shakespeare, *Othello*. ed. Ernst A.J. Honigmann, Arden Shakespeare (London: Thomas Nelson and Sons, 1997).

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7 Out of "Their Covert of Words"

Cipher and Secrecy in the Writing of Early Modern Algebra

Lisa Wilde

I

One of the first algebra problems posed in English concerns a coded message of great urgency. In Robert Recorde's dialogue-style *The Whetstone of Witte, Whiche is the Second Parte of Arithmetike* (1557), a Master engaged in tutoring his pupil in "the arte of Cossike numbers" (an early form of algebra) tells a story of a herald to a king's army, who, being "corrupt[ed]… with giftes" by an enemy general, unwisely swears

> … that he will tell hym, how many Dukes, Erles, and other souldiars there are in that armie. The Heraulte lothe to lease those giftes, and as lothe to bee untrue to his Prince, diviseth his aunswere, which was true, but yet not so plain, that the adversarie could therby understand that, which he desired. And that aunswere was this. Looke how many Dukes there are, and for eche of them, there are twise so many Erles. And under every Erle, there are fower tymes so many soldiars, as there be Dukes in the fielde. And when the muster of the soldiars was taken, the .200. parte of them, was 9 tymes so many as the number of the Dukes. This is a true declaratio[n] of eche number, quod the Heraute: and I have discharged my othe. Now gesse you how many of eche sorte there was.[1]

The Scholar character in this instance notes dubiously that the question "seme[s] harde," but he successfully solves it by applying the central "Rule of Algeber" as previously taught in the text: in response to any question, "you shall imagin a name for the nomber, that is to bee sought," frame it as a "Cossike nomber…accordyng to the question," and then (to borrow a clearer phrase from a later work) "suppose that done, which is desired," reducing the equation until the result "doeth aunswere to the question."[2] (The solution in this case is: 225 dukes, 450 earls, 405,000 soldiers).[3] At the heart of this successful resolution is the deployment of the *coss*, or "thing," with the exotically-charactered "cossike nombers" that derive from its degrees: ℘ for a constant, ȼ for the unknown "root",

ȝ for a square number, and so forth. At once expressive and occult, it is the coss, or the imagined name for a number not yet found, that accomplishes the paradoxical work within the problem of producing a "*declaration*" that is "true, but yet not so plain," that a reader "could therby understand" its meaning.

The *Whetstone of Witte* stands at the eve of a critical era for the development of algebra. Early versions of the art, based largely on imported texts from the Arab world (notably the *al-Kitāb al-mukhtaṣar fī ḥisāb al-jabr wal-muqābala* of Muḥammad ibn Mūsā al-Khwārizmī, from which our word "algebra" is derived) would soon be supplemented by the rediscovered works of classical mathematicians like Pappus and Diophantus. The decades following would see a tremendous expansion in the power of algebraic technique, the gradual algebraization of geometry, and the development of new methods and modes of notation leading up to Isaac Newton's calculus in the 1670s.[4] And while the specific cossic modes of algebra employed by Recorde would fall into disuse by the end of his century, the conceptual form of the riddling, enigmatic message—the truth expressed but not yet recognized or fully grasped—remains central to the work of algebra throughout the period to follow.[5] Indeed, as Jacob Klein famously argues, many of the era's notable mathematical advances are predicated on a wider phenomenal shift that specifically repositions empty, indeterminate quantity (conceptualized as *general magnitude*, as opposed to *a definite number of definite things*) as a central object of mathematical investigation.[6]

Side-by-side with this shift in the understanding of mathematical object came a parallel development in the modes of notation by which such objects, with their relationships and transformations, could be represented on the page. Gradually and in piecemeal fashion, the "rhetorical algebra" of the early sixteenth century, the techniques of which are described entirely in continuous prose, was supplemented, first by cossic symbolism, and later, in the work of François Viète, Thomas Harriot and their successors, by variants of literal notation, with a variety of spatial and figural techniques for representing powers. The symbol for equality (Recorde's invention!) was formalized, as were notations for operations like addition, subtraction, multiplication, division and ratio, until by the start of the eighteenth century the language and character of algebra assumed a form that is somewhat recognizable to us today.

Understandably, the standard historical narrative of the period has framed this emergence of algebraic symbolism, in conjunction with the demonstrably increasing power of algebraic technique, as a much-needed *advance* toward representational clarity, a more-or-less straightforward sweeping-away of the obfuscatory trappings of rhetorical algebra to expose to more immediate view the mathematical matter itself. In broad view, it is certainly correct to describe the notation of the late seventeenth century as possessing both more clarity and more power than that

used in Recorde's day. In more local terms, however, final causes do not always align with efficient ones, and any narrative of the development of symbolic algebra as a textual practice must account not only for an overall progress, but also for various puzzling nonlinear moments of discontinuity, regress, and conspicuously missed opportunity along the way. Indeed, at the level of individual texts, as Jens Høyrup notes, the "inherent logic" that we now see in the evolution of algebraic symbol often appears "not understood—nor intended—by the participants in the process." Authors' notational choices seldom chart a straight path forward, so that progressive trends in symbolic expression frequently "become invisible in a close-up picture."[7] This oddly stochastic quality may speak to the complex role of symbolic "encoding" in mathematical practice, with notation functioning not just as a neutral container of information but as one among many mental models of the mathematical object itself, subject to sometimes-unpredictable interactions with the other cognitive domains comprising the human "number sense."[8] In this essay, however, following the precedent of Recorde's herald, I should like to press this insight a step farther still, inquiring into the idea of the emerging symbolic algebra as *code* in the more conventional sense. Can the same representational forms function as a means at once of clarification and of encryption? What might it mean to explore early symbolic algebra, as Recorde does, as a source of declarations enigmatically "true," but *not* always "plain"?

The idea of a productive overlap between algebra and cipher is not a new one: in a 1997 essay, Peter Pesic argues compellingly for a functional parallel between Viète's systematic methods of algebraic analysis and his work on cryptanalysis, and a considerable body of recent work (by Antoni Malet and Giovanna Cifoletti, among others) explores ways in which the emerging discipline of algebra frames itself at various points as a language.[9] But as Recorde's riddle suggests, our understanding of the status both of mathematics and of ciphers in the early modern period stands to benefit from a closer reading of narrative dynamics of secrecy and hiddenness in mathematical texts themselves. Mathematical symbols both participate in and productively complicate the wider Renaissance project of restructuring the phenomenal world by experimenting with modes of signification that are *both* more and less immediate, more and less legible, than "natural" language in speech—a project that includes, in our period, not only symbolic algebra and cryptography itself, but also shorthand, phonological notation, and various schemes for "universal languages" based on new characters or signs. Particularly in the untidy emergent phase of algebraic symbolism, in the late sixteenth and early seventeenth centuries, authors' uses and abuses, praises and detractions, of figure in the *process* of mathematical thinking can also shed important light on how early modern quantitative logic works outside the specialized realm of algebraic technique. In what follows, I

will explore the function and perception of algebraic/arithmetical symbol as a code—*both* in its patency, and in its hiddenness—in the related work of two English figures noted as mathematical popularizers and educators, as well as symbolic innovators: William Oughtred (1574–1660) and John Wallis (1616–1703).

II

We have said that Renaissance algebra was, from its earliest stages, a science fundamentally concerned with *coding*, and that (notwithstanding our modern associations with the "sea of *x*s and *y*s and *z*s" of mature symbolic algebra) the semiotic history of the discipline draws in a number of complexly evolving, often overlapping ways of representing general quantity and relationship. It is worth clarifying, however, that perhaps the most critical development for algebraic thinking in the West involves the arrival of a sign-system that is not generalized at all. The Hindu-Arabic system of decimal notation for number, which arrived in the fifteenth century and over the next 300 years, slowly came to replace older Roman forms of notation across Europe, and both opened a vastly expanded set of computational possibilities and prompted a swell of popular interest in *arithmetical* ways of conceptualizing the world. While algebraic techniques had been known in the Arab world since the tenth century, the earliest Western discussions on the topic come as extensions of the burgeoning popular literature on *algorism* (a corruption of the name of al-Khwārizmī), or arithmetical computation using Hindu-Arabic number, and present algebra as "the second part of arithmetic," merely a more generalized form of the powerful techniques of decimal calculation. In the course of the succeeding decades, key advances in the representation of *particular* numbers—notably, development of decimal fractions by Stevin, and of logarithms by Napier and Briggs—occur side-by-side with developments in the notation of generalized numbers for purposes of algebraic analysis. By the end of the seventeenth century, the mathematician John Wallis, taking a retrospective look over the field's history in his *Treatise of Algebra* (1685), notes "the *NumeralFigures*," "Decimal Parts," and logarithms alongside Viète's "*Specious Arithmetic*… by notes" as equally important stages in the "Original, Progress, and Advancement" of algebra to his day.[10] Whether in general terms ("*sub specie*") or with reference to particular numbers, then, the discipline's new representational forms contribute alike to a common project of exploring the world in *arithmetical* terms—that is, through operations on number and quantity, as opposed to the spatial relationships of shape and proportion that had structured the universe of classical geometry.

Perhaps unsurprisingly, given this wider interest in the structure, powers, and possibilities of novel systems of representation, a number of

early practitioners of algebra seem also to have dabbled in cryptology—both in the creation, and, especially, in the decoding of secret languages. In Wallis's autobiography, an extended account of the author's cryptanalytic activities serves as a sort of narrative bridge between the author's youthful, fugitive study of "*Common Arithmetick*" and his later career as mathematician and scientist. On the eve of the Civil War, Wallis tells of being shown a letter coded using alphabetic substitution, "[which] was indeed the first thing I had ever seen written in *Cipher*," and which he succeeds in deciphering "in about 2 hours time." Wallis's next attempt, on a state letter "in Numeral Figures, extending in number to seaven hundred, with many other Characters intermixed," is less straightforward: he at first is "backward… to attempt it," and subsequently

> after I had spent some time upon it, threw it by as desperate: But, after some months, resumed it again, and had the good hap to master it… [so that], being encouraged by this success, beyond expectation; I afterwards ventured on many others… and scarce missed of any, that I undertook.[11]

As a postscript, Wallis notes, ruefully, that subsequent developments in "intricate" Continental cipher have somewhat reduced his overall rate of success. Still, as D.E. Smith points out, Wallis's cryptanalytic services across several English regimes were sufficiently noteworthy to win him at least two ecclesiastical appointments, as well as sundry other Court favors.[12] Wallis's mathematical circle at Oxford also included a number of others sharing his interest in cryptology—notably, John Wilkins, whose *Mercury, or the Secret Messenger* (1641) offers one of the century's more thorough expositions of theoretical underpinnings and diverse historical practices of secret communication.[13] And among the previous generation of algebraists, both Viète and Girolamo Cardano had written extensively on the science of secret codes—the latter describing cryptographic methods allegedly so rigorous that decipherment "would require an Apollo," and the former claiming, conversely, to offer an "infallible rule" for cracking any possible cipher.[14] While the practical veracity of both sets of claims is open to question, it is nonetheless the case, as Peter Pesic suggests, that the wider *pursuit* by algebraists of the perfect cipher, on one hand, or of the infallible key, on the other, speaks to a common project of investigating the relationship between *meaning* and *information*, exploring ways in which formal operations across and within representational systems—encoding, transcoding, and algorithmic transformation, arithmetical or otherwise—can change the availability of meaning while preserving informational content intact.[15]

In their general interest in "Secrecie… Publish'd," of course, there is little to distinguish Viète, Cardano, and other cryptographically-inclined figures from early modern scientists in other disciplines, who, as William

Eamon notes, shared a common stock-narrative of research as a lively hunt after "the secrets of nature."[16] But in this case, a cluster of shared vocabulary between analysts algebraic and cryptologic alike signals a more specific commonality of approach between the two. Both algebra and cryptography characteristically deploy modes of "analysis" to "resolve," "solve," or "reduce" their coded problems, looking inward for a truth that must be teased out of the knotty core of the stated problem itself; the cryptographer Samuel Morland, indeed, will borrow directly from the terminology of cossic algebra to declare his codes proof against any "*Zetetick* and *Analytic* devices" whatever.[17] Most conspicuously, of course, both pursuits deal at bottom with "ciphers," a term that belongs originally to algorism (referring simply to the ten Hindu-Arabic "figures of number"), but which quickly acquires its cryptographic sense via the popular perception of such exotic figures' semiotic opacity. Even for those arithmeticians perfectly comfortable with computation *per cifras*, the orientation to the investigation and manipulation of the "cipher" signals in both mathematics and cryptography a form of knowledge immanent in character and written sign, self-contained within the formal world of the printed or written page, and invested in the power of relationships on that page to elucidate or even to create underlying patterns of logical relationship. Dealings with cipher, in this sense, should perhaps be positioned in continuity with other contemporary experiments in the significatory power of systematic but arbitrary character: Timothy Bright's "Characterie" or shorthand, for instance, which also proposes itself paradoxically both as a mode of encryption and as a universal language; and the algebraist Thomas Harriot's set of phonological characters for analyzing the Native American languages encountered by colonists in the New World.[18] In all these cases, *the character itself*—the "coss" in the sense of a coded *thing*—stands, paradoxically, as hunt, quarry, and capture all at once: the relevant critical insight is at once reached through the act of symbolization and encoded in it. (Thus, Harriott's researches in Algonquin and algebra alike, as Jacqueline Stedall points out, are "almost wordless"; the process of discovery, its content, and its demonstrative logic are all wholly encapsulated by the same spatialized array of symbols on the page.)[19] Here, too, the status of the message as vehicle of meaning depends critically on the external act of *recognition* by which a reader identifies the underlying logic being conveyed—or, in the case of an encrypted code, in the failure of that act of recognition.

III

The cognitive dynamics of this interaction between *code* and *message* remain to be elucidated as we consider what to make of the early modern alliance between cryptography and algebra. What does it mean to hunt truth in character? In phenomenal terms, what is the nature of the

quarry, and what the experience of the hunt? To explore these questions, I will turn to the algebraic work of a figure who stands among seventeenth-century mathematicians both as a precocious symbolist and as an explicit promoter of the use and development of symbolic notation. Oughtred, indeed, is interestingly positioned at the temporal center of the early modern revolution in algebra. Old enough to have learned his arithmetic from Recorde's works as a boy, and sufficiently long-lived to have corresponded with Wallis at the eve of the development of the calculus, he is credited not only with several technical innovations (including the invention of the slide rule), but also, most critically, with the authorship of a summary text, the *Clavis Mathematicae* (1631), that in England became the canonical introduction to algebra well through the middle of the century. Through the *Clavis*, its subsequent English translation (*The Key of the Mathematicks New Fil'd,* the 1647edition to which I will refer in this piece), and decades of private tutoring at his Albury rectory, Oughtred provided the first exposure to algebraic ideas for a generation of English thinkers, including Seth Ward, Christopher Wren, and Wallis himself.[20]

Oughtred is perhaps most conspicuous in present-day scholarship for having authored one of the period's most lucid and frequently-quoted justifications for the use of algebraic symbolism. Writing in an introductory address to *The Key of the Mathematicks*, Oughtred defends his decision to write not "with verbous expressions, but… with symboles or notes of things instead of words." Though it may "see[m] to many very hard," he promises,

> This specious and symbolicall manner, neither racketh the memory with multiplicity of words, nor chargeth the phantasie with comparing and laying things together; but plainly presenteth to the eye the whole course and processe of every operation and argumentation…. Wherefore that I might more cleerly behold the things themselves, I uncasing the Propositions and Demonstrations out of their covert of words, designed them in notes and species appearing to the very eye.[21]

Oughtred's imagery here sets forth a clear and consistent narrative for the epistemological function of symbol in his text: "words," both in the copious prose of earlier rhetorical algebra texts and, by implication, in the algebraic story-problem itself, become the sylvan "covert" from which the mathematical quarry must be laboriously "uncased," while symbol functions by contrast to present "the things themselves… to the very eye." Intriguingly, there is a hint that even the concrete nature of the quantities being analyzed (presumably, the earlier "things" whose comparison and "laying… together" so unpleasantly "chargeth the phantasie") may be part of the superfluous encasement from which the symbolized "species" must be released. While in Recorde's problem

the analytic process worked to reveal a sum of Dukes, the Dukes here become an unnecessary encrustation on the charactered sum. At least in this hortatory opening section, then, the operation of symbols is framed as a simple process of exposition: presented with a world complexly encrypted in words and objects, Oughtred promises, algebraic symbols will work to decipher the plain quantitative reality.

In light of these strong claims for the inherent transparency of symbolism, however, I would argue that we should be equally interested in Oughtred's passing acknowledgment of the "many" readers to whom the notational exposition of things "to the very eye" will nonetheless "seme… very hard." This was in fact the experience of a number of readers of the *Clavis*, who frequently both sought clarification through correspondence and came in droves to Oughtred's home in search of personal instruction to supplement the work (Oughtred, a rector by profession, is recorded as having generously offered his tutoring *gratis* to all comers).[22] An anecdote from a contemporary tells of Seth Ward and Charles Scarborough, both of whom were to become notable mathematicians in their own right, making a pilgrimage to Oughtred's Surrey home "to be informed in many things in his *Clavis mathematica* which seemed at that time very obscure to them"; Wallis himself, discussing Oughtred's contribution to the history of the field, agrees that "there are who find fault with his Clavis, as too obscure."[23] These background experiences of *non*-recognition lend an implicit polemical edge to Oughtred's praises of symbolism, and (whatever our own retrospective perceptions of the forward-thinking character of his notation) they should perhaps prompt us to attend to his language less as plaintext than as code, equally important for its capacity both to facilitate and to obstruct access to the information.

Within the cognitive work of algebraic analysis, then, what does Oughtred's emerging algebraic symbolism reveal, and what conceal? Here, again, one version of the story is very plain. After reviewing the sign-systems used to conduct "Numerous *Arithmetic*," in Hindu-Arabic figures of number, in decimal fractions and in logarithms, the *Key*'s opening section proceeds logically to explain the parallel art of "signif[ying] Magnitudes… by Species," a form "more appliable to the Analyticall art…

> For in the Numerous [Arithmetic], the numbers with which we worke, are so, as it were, swallowed up into that new which is brought forth, that they quite vanish, not leaving any print or footstep of themselves behinde them. But in the Specious [Arithmetic], the species remaine without any change, shewing the processe of the whole worke: and so doe not onely resolve the question in hand; but also teach a generall Theoreme for the solution of like questions in other magnitudes given.[24]

This discussion seems, reasonably enough, to foreground the charactered magnitude as the real matter of symbolic exposition in algebra, promising a sign-system that will crystallize a problem's arithmetical parts as situated within their wider structure of quantitative relationships, rather than allowing component magnitudes to be (in a vivid image) "swallowed up" into a single numerical solution. And indeed, the deployment of symbolism in the *Clavis* partly bears out this character. With limited exceptions, Oughtred generally employs the "species" A and E to represent, respectively, the greater and lesser of two basic magnitudes within an algebraic analysis: thus, in the specious version of simple addition,

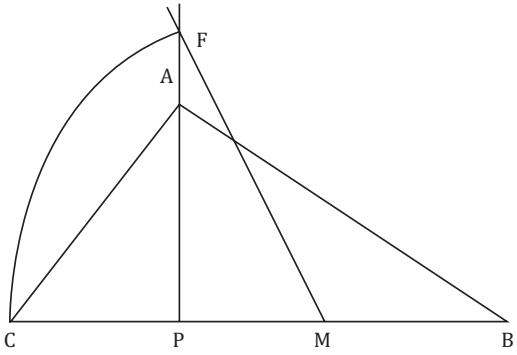
$$\begin{array}{r} A \\ E \\ \hline A+E \end{array}$$

the two component magnitudes A and E do indeed remain present "to the very eye" even after the operation has been completed. Surprisingly, though, in practice, the *Key* makes heavy use not only of these granular forms, but also of a fairly elaborate set of symbols for composite magnitudes, setting **Z** as "the summe [of A and E,] **X** the Difference…ƶ the Sum of the Quadrats. x. the difference of the quadrats. ƺ the Sum of the Cubes. ƪ the difference of the cubes," and so forth.[25] Though seemingly contradictory of Oughtred's stated dislike for forms that "swallo[w] up" component magnitudes into an opaque composite, both the symbols Z and X can perhaps be explained as simple ways of representing the *lines* or sides of intersecting geometric figures, from whose comparison A and E are frequently derived in the *Clavis*. By comparison with the cossic analysis of Recorde's day, algebra by the 1630s is considerably more invested in the arithmetical recasting of problems traditionally regarded as geometric. But the mirrored symbols x./ƶ and ƪ/ƺ to represent sums and differences of squares and cubes, respectively, are somewhat more difficult to understand as part of an overarching commitment to detailed and transparent representation of the arithmetical thing itself. In fact, the *Key*'s deployment of symbol only intermittently achieves the immediacy of quantitative presentation that we, from a modern perspective, associate with the central mission of symbolism. Nor does it instead (to pursue another possibility) lucidly discover to the eye the more dynamic "reality" of the relation or transformation of quantities via algebraic analysis: indeed, as Florian Cajori points out, some important aspects of arithmetical relationship are obscured by Oughtred's choice of operational symbols (using a separate notation (::) to indicate the equivalence between two pairs of quantities in the same geometric proportion, for instance, versus simply indicating the relationship as a form of equality), and the *Clavis* is occasionally obliged to propose rules for the operation of symbolism (notably, rule of signs by which two negative numbers

multiply to a positive) that in this period cannot be explained as part of quantitative reality at all.[26]

The complexity of this relationship between symbol and mathematical matter comes interestingly to the fore in Chapter XIX of the *Key*, where the text moves on to render "Examples of Analytical Aequation, for inventing of Theoremes, and resolving of Problemes," by supplying algebraic demonstrations for a series of propositions from Euclidean geometry. For each problem set, the text offers a triplicate resolution: the solution is first expressed in symbolic algebra, then paraphrased in words, then, finally, produced via geometric construction, with the visual aid of a diagram. As a means of showcasing the brevity and figural elegance of symbolic algebra against a background "covert" of words and things, the instructional design here succeeds admirably. The rigorous formal equivalency between symbolic, verbal, and constructed representations of each problem compellingly demonstrates to a reader that geometric entities can indeed be successfully expressed and manipulated in arithmetical terms.[27] Reading through the problems as cognitive process, however, one is equally struck by the phenomenal *non*-equivalence of symbolized, verbalized, and constructed objects—and by the text's relative lack of effort to engineer the moments of readerly recognition that might help to align the three as parallel reflections of a common reality. Problem XI, for instance ("If *CA* one Side of a Rectangle Triangle, and *BP* the Alterne Segment of the Hypotenuse, be given: to finde the other segment, and the Triangle it selfe"), proposes a challenging question: effectively, how to construct a complete right triangle given only the base and a fixed segment of the hypotenuse. Figure 7.1 shows the *Clavis*'s diagram of the problem at top, with excerpts (a) and (c) below giving, respectively, Oughtred's algebraic solution and his subsequent account of the corresponding geometric construction (which relies ingeniously on producing the right triangle *MPF*, whose sides relate AC to 1/2 PB). For the reader's convenience, (b) gives a modern-notation version of Oughtred's algebraic proof in (a).

The algebraic solution here is by no means unrelated to the spatial problem, and indeed it draws implicitly on geometric principles at various points: notably, in the relationships between similar triangles that create the initial proportions *BP* + *CP.CA*::*CA.CP*, and in the procedure for completing the square that provided the basis for the solution to quadratic equations given in Chapter XVI, Section 9 (and referenced at the last step of the demonstration). But if the stated intent of the *Key* is to ground its thinking in the "course of operation… appearing to the very eye," then what is explicitly "presente[d] to the eye" in (a) is decidedly not made equivalent to geometric demonstration that follows. Indeed, the text deliberately neglects the opportunity to establish symbolic links between, for instance, the final solution to the quadratic equation in (a) and the Pythagorean relationship between sides of the right triangle *MPF*. As



(a) Imagine that effected which is desired: And let the Rectangle Triangle be *BAC*. Because $BP + CP.CA :: CA.CP$. It shall be $BP \times CP + CPq = CAq$. Wherefore by 9 C.XVI, $\sqrt{q}: \frac{1}{4} BPq + CAq: -\frac{1}{2} BP = CP$

(b) $(BP + CP): CA :: CA: CP \rightarrow BP * CP + CP^2 = CA^2 \rightarrow \sqrt{\left(\frac{1}{4} BP^2 + CA^2\right)} - \frac{1}{2}$ BP = CP

(c) Geometrically thus: Set at Right Angles, *BP* and *PF* = *CA*. And cutting *BP* in Halfes at *M*, draw *MF*: and measure *MC* = *MF*. The other Segment therefore *CP* is found, and also *BC* the whole Hypotenuse. On the Diameter *BC* describe a Semicircle; in which inscribe *CA* and *BA*.

Figure 7.1 Diagram of Key Chapter XIX, Problem XI, with parallel algebraic, modern-notation algebraic, and geometric solutions William Oughtred, *The Key to the Mathematicks New Forg'd and Filed*, 93; author's own modern-notation transcription.

a result, the relationship of algebraic to geometric demonstration reads less like that of a plain-style message to its rhetorically elaborated version and more like that of a plain-*text* to a code—or perhaps, more like two differently-encrypted versions of the same message, a double set of grilles placed over a single (but never wholly disclosed) underlying text. Indeed, while Oughtred memorably promotes the use of his algebraic symbolism as a simple process of clarification, a straightforward liberation of the radical quantitative meaning hitherto hidden in a "covert of words," the parallel presentation in Chapter XIX points up ways in which this method achieves its compact presentation of analytic operations "to the eye" only by deliberately removing other critical information from view.

What *is* being made plain in the *Key*'s algebraic symbolism, I would suggest, is not geometric form, nor, perhaps, even quantitative relationship itself, but *operational process*: the codified sequence of arithmetical transformations that, once derived, offer a mechanical means of solving any problem constructed along similar lines.[28] The distinction, to be sure, does not critically change our understanding of the formal

substance of the algebraic practice itself (after all, Oughtred himself had assigned as one key benefit of symbolism its "teach[ing] a generall Theoreme for the solution of like questions in other magnitudes given"). It does, however, productively complicate our wider sense of how quantitative reasoning works in the new space of symbolized number; and in particular, it casts some doubt on the *Key*'s initial boast that a properly-disposed symbolism will produce mathematical learning through immediate, uncomplicated scrutiny of the "things themselves."

In fact, not withstanding algebra's promised powers to produce direct mathematical intellection through symbol, the shape of Oughtred's computational practice in the *Key* and elsewhere seems to register a firsthand experience of discovery rather closer to that of his hapless pupils: that is, a mixture of purely mechanical symbolic manipulation and the occasional flashes of insight that we have already seen to be characteristic of work in a partly-occluded or even encrypted space of ideas.[29] As we have seen, one key feature of Oughtred's symbolism is its capacity to foreground *operation*; but in its treatment of operation both on numbers and *sub specie*, the *Key* is often surprisingly mechanical, following earlier arithmetic manuals in emphasizing algorithmic "recipes" for calculation (generally including helpful practical details, such as directions for "pointing," arrangement and motion of figures on the page) while only intermittently bothering to rationalize procedures with reference to any larger framework of mathematical truth. A section on reducing equations where "those things which are given… be mingled with those which are sought," for instance, proceeds not by explaining the reasonableness of diminishing two equal quantities by the same given amount, but by flatly instructing, in purely mechanical or formal terms, that "there be a Transposition of the Magnitudes, from the one side to the other, under a contrary signe."[30]

This concrete and instrumental approach to symbolized process, indeed, extends past the *Key*'s direct instruction on analytic technique to encompass even its treatment of the equality-relations that in theory constitute the central object of algebraic investigation.[31] In a long section entitled "The Analytical Store," Oughtred praises the "innumerable other" equations to be "deduced by Addition, Subduction, Multiplication, Division, Transposition," from the basic identities described in the *Clavis*, not as a font of knowledge, but as a sort of handy craftsman's toolkit: the total set of these identities, he explains, constitutes a "precious" and "plentious" store of "Analyticall furniture," serving, like other ingenious inventions of Renaissance science, at once as the tool and the "devi[ce]" of the studious practitioner:

> And wheresoever, whether in Arithmetique, Geometrie, or in any other Art, he shall light upon some magnitude, to which another is understood to bee equall; he shall turne, wrest and vary, that Æquality by whatsoever meanes and comparings he can; that from thence he may find out a new Instrument of Art; which afterwards

> he shall keep in Store; and wheresoever occasion serves, bring it forth for the helpe and advancement of the Art.[32]

Setting aside the quietly audacious assumption of arithmetical identity as a sort of all-purpose instrument, universally available for the cracking of hard problems across the spectrum of "Arithmetique, Geometrie, or… *any other Art*," this passage is notable for the concrete pragmatism of its description of the algebraist's art. The equation is not here a transcendent or divine form whose lineaments are carefully brought into view through the medium of a transparent symbolism; instead, it is framed as a mere recalcitrant object, to be promiscuously "turn[ed], wrest[ed] and var[ied]" into shape using "whatsoever meanes and comparings" may suit the practitioner's best judgment, and the devising of such instruments is emphatically classed as a matter of practical art, not science.

Equally worth noting for our purposes, however, is the slippery methodological indeterminacy at the heart of Oughtred's injunction that the analyst use "whatsoever meanes… he can" and act "wheresoever occasion serves" in pursuit of a resolution to the equation at hand. Earlier portions of the *Clavis* had offered a disarmingly simple account of the process of analysis in symbolic algebra: "having used a fit Ratiocination, for the magnitude sought" in a problem, and assigned *species* accordingly, one need only set the processes of arithmetic to work in "translat[ing] and compar[ing] both the given and sought Magnitudes… until at length there be found something equall" to the quantity desired.[33] By contrast, the indefinite "wheresoever" and "whatever"s at the edge of the description hint at a process of discovery in reality both more protracted and less predictable than the simple expository or "translational" account of analysis would suggest. Thomas Hobbes, in the course of a more general mid-century critique of the uses of symbolism by analysts, detects and responds irritably to this gap between the promises of absolute clarity associated with symbolic analysis and the necessary element of uncertainty in its application:

> the Rule, both in Mr. *Ougthred*, and in *Des Cartes* is this, *When a Probleme or Question is propounded, suppose the thing required done, and then using a fit ratiocination, put A or some other vowel for the magnitude sought*. How is a man the better for this Rule without another rule, *How to know when the ratiocination is fit*? There may therefore be in this kind of Analysis more or less natural prudence, according… as one man in chusing of the unknown Quantity with which he will begin, or in chusing the way of the consequences which he will draw from the Hypothesis… A man may sometimes spend a whole day in deriving of consequences in vain, and perhaps another time solve the same Probleme in a few minutes.[34]

As will be discussed at greater length below, Hobbes is by no means an impartial commenter in the case, but here his critique of the

methodological limits of symbolic "rule" gains credibility from its close correspondence with what the *Key* itself tells us about how the cognitive activity of analysis *sub specie* was perceived by its practitioners. Oughtred praises highly the expository clarity of his own methods, but his passing accounts of their use seesaw between the frankly mechanical (as we have seen above) and the intuitive or serendipitous, as highlighted by Hobbes. Explaining his algebraic proof of "the area of a plaine Triangle," Oughtred confides that once he had been sent the problem by a friend, he was obliged to "[think] upon it… a while," when finally "there came to my minde 17. Ch: XVIII. Theor:20, which seemed most fit for the loosing of the knot."[35] Here, in practice, the problem in algebra is *at once* "a knot," an opaque but palpable object to be "loosed" by careful mechanical means, *and* a riddle, an occult or coded message whose key comes suddenly to mind (to quote the same author on another occasion) "as if infused by a divine genius, after I had thought on it without succesee for a year, two or three."[36] We should note the narrative parallels here to Wallis's own account, quoted earlier, of unexpectedly finding himself with "the good hap" to master a long-abandoned cipher: the long frustration, the mysterious flash of insight here, are emphatically characteristic of the codebreaker's experience in the early days of cryptography. Knowledge is indeed encoded, transmitted and received in the process of Oughtred's "fit" symbolic "ratiocination," then—but in ways that frequently seem far more characteristic of the secret or encrypted message than of the clearly-charactered open book.

As part of the larger group of cognitive phenomena that Cardano had placed under the rough heading of "subtilitas" (that is, "a certain intellectual process whereby… intelligible things are comprehended by the intellect, *but with difficulty*"), the value of this element of intuition or serendipity in human dealings with formal systems had been a topic of some debate through the early modern period, particularly among Oughtred's fellow-mathematicians.[37] Gottfried Wilhelm Leibniz, writing in the character of "Theophilus" in his *New Essays on Human Understanding*, would praise the "inspired guess" that in "the art of… deciphering… often provides a generous shortcut," even going so far as to propose this thought-move as a model for "discovering… hypotheses" in research more generally, since it typifies the human capacity to elucidate causation by recognizing where given knowledge can apply to new situations.[38] By contrast, Descartes, writing over a half-century earlier, had recommended code-breaking as a valuable exercise in the mental habits necessary for scientific discernment, but he cautioned against pursuing discovery "by making random and unmethodical guesses about similarities." Instead, he suggested, the student should proceed more "methodically" via a combinatoric approach, "so as to test every conjecture we can make about individual letters, words, or sentences, and… by an enumeration… discover what can be deduced from them."[39] While

this brute-force approach, if applied to algebra, would certainly have helped address Hobbes's concerns about the role of chance, occasion and "natural prudence" in determining the choice of direction for algebraic transformation, the exhaustive and fully methodized approach to the resolution of equations remains an unmet promise well through the end of the seventeenth century. For better or worse, then, the reader's sudden insight—the rush of serendipitous recognition that simultaneously creates meaning and marks a space as previously hidden—remains an important element of the process of mid-seventeenth-century mathematical advance.

The dual cognitive modes of the new algebra, both mechanical and mystical, thus stand in mutual contradiction to the flattering self-conception of symbolic analysis as simply exposing "the things themselves… to the very eye" of the rational analyst—but also, I would argue, in interestingly complex relation to each other within the wider cognitive landscape of early modern science. In his 1979 essay "Clues: Roots of an Evidential Paradigm," Carlo Ginzburg draws a dichotomy between two fundamental "epistemological model[s]" for converting sensory data to human knowledge: the "evidential" or "statistical" approach, and the "divinatory, conjectural, or semiotic" paradigm. The former, associated with science and mathematics, he argues, is based in "quantification and repetition of phenomena," and oriented toward rational exploration of the systematic, the universal, and the ideal. The latter, by contrast, grounds itself in minute details of material experience and works inferentially to "construct… through traces, symptoms and clues, a complex reality that could not be experienced directly," relying on the "lightning" access of an uncodifiable intuition to read through from trace or clue to full narrative.[40] Eamon, elaborating on Ginzburg's ideas in the context of the development of early science, links the early modern operation of this divinatory paradigm to the Greek concept of *metis*, the craftsman's "cunning" or "practical intelligence" that sets aside "rigorous logic" to focus instead on quick judgments about ambiguous or changing situations, thus aiming to explicate "the sensible world of becoming rather than the intelligible world of being."[41] A renewed sense of the value of *metis* or conjecture as a mode of discovery, Eamon argues, undergirds much of the early modern transition away from the rigorously logical and demonstrative methods of scholasticism and toward a Baconian model grounded in imaginative inference from particular observations.[42] I have suggested, *contra* our perceptions of symbolic mathematics as above all transparent, clear and unambiguous, that we can also recognize something akin to a conjectural or metic process in Oughtred's accounts of his "long thinking" and serendipitous insight in pursuit of the *Clavis*'s solutions, or in the indeterminacy of the "fit ratiocination" that so troubles Hobbes. Yet at least as implemented in some early modern algebraists, the workings of this "natural judgement" also interestingly complicate any simple division between Ginzburg's

"statistical" and "divinatory" paradigms, or between demonstrative and conjectural methods of knowledge-making. Critical to our understanding of the operation of Oughtred's symbolism is that the new practice of analysis *sub specie*, while it includes in practice elements of the contingent or conjectural, is nonetheless held to encode forms of truth which *are* rigorously demonstrative, precise, and universal. Oughtred's algebraic colonization of geometry in the *Clavis* is arguably intended to lay arithmetical claim to precisely the status Galileo had claimed for geometric form: that of being the character in which "this grand book, the universe" is written.[43] Even under symbolization, mathematics, as we have seen, still retains its status as a divine *language*, with all the accompanying promises of rigorous coherence, inherent significance, and powerful universal applicability that that term implies: in sitting down to resolve a third-degree equation, the analyst addresses not a crime-scene or a quarry's footprint but a divine text deliberately inscribed by the Creator. What has changed may best be described, drawing on James Bono's account, as a shift to a view of this divine inscription as a mere "contingent" and "fictive" operation of God's will, versus a transcendent and eternal reflection of the divine mind itself—a language, therefore, that is naturally partly hidden, susceptible to the same modes of rough-and-ready investigation (the felicitous guess, the creatively defamiliarizing reappraisal) as the puzzle, the riddle, or the coded message.

IV

I have argued thus far that the *encrypted message* may offer a useful model for understanding the complex function of charactered quantity in the early days of symbolic algebra. This evolution in practice entails coming to terms with a process of mathematical investigation that is (in subjective, if not in formal terms) partly conjectural. Whereas the truths of geometric demonstration had arrived in concrete, manageable increments, the analyst in the newly-developing space of symbols must be content instead to trust in flashes of intuitive recognition to render, unbidden, the computational insights that sometimes resist more deliberative inquiry. In making this suggestion, however, it also seems fair to ask what is *important* about these new structures of mathematical cognition. Do the more enigmatic contours of early symbolic practice genuinely merit our attention as part of a history of mathematical thinking—or can these be safely dismissed as instances of understandable slippage and confusion by practitioners still muddling their way toward the more powerful and fully-realized symbolism of the later seventeenth century? I should like to address these questions by turning briefly at last to the work of John Wallis, whose testimony—as a cryptanalyst, an historian of algebra, a student of Oughtred and an appreciative devotee of his symbolism—has at various points inflected our discussion thus far. During the seventh year of his tenure as Savilian Professor of Geometry at Oxford, only a

few years after journeying to study with Oughtred in Surrey and three decades before he would publish the grand *Treatise* tracing the origins of algebra all the way from the figures of Hindu-Arabic algorism through Viète, Oughtred and beyond, Wallis produced a work of arithmetical analysis, his *Arithmetica Infinitorum* (1656), whose insights provided a "crucial step" toward the development of Newton's calculus.[44] In this work, Wallis draws on the earlier insights of Continental mathematicians to conceptualize, counter intuitively, curved spaces as collections of indefinitely small parallellograms, thus allowing the area under any regular curve to be computed as the sum of an infinite arithmetic series.[45] Using this technique, he goes on to suggest methods for the quadrature of a number of curves, concluding by proposing a solution to the critical, millennia-old problem of squaring the circle.

What is remarkable about Wallis' work, as discussed most recently by Jacqueline Stedall and Douglas Jesseph (among others), is that his powerful conclusions are reached by means of a wholly indefensible logical method—and one, we should note, that is grounded in what we might call a distinctly cryptanalytic approach to number. The central value of the *Arithmetica*'s method of infinitesimals is that by their means (as Wallis explains) "a geometric problem is reduced purely to arithmetic"; but to arrive at his general arithmetic formulae for the sums of infinite series, Wallis simply works a few initial cases, recognizes a pattern, then relies on the logic of operational process to guarantee that the pattern will continue to apply over the remainder of the series. The codebreaker's quick act of recognition thus acquires a certain demonstrative force: in an imagined universe of number that is, like a mode of encryption, at once perfectly regular and somehow contingent, arbitrary or obscure, it is not necessary to probe the underlying causal basis for an arithmetical pattern, but only to "exhibit the thing to a certain extent" and proceed infallibly thence to a "general proposition."[46]

As a somewhat audacious assertion of the power of arithmetical number and sign (as against geometry's line and space) to productively encode the phenomenal universe, Wallis's conclusions were predictably taken up into a larger debate about the epistemological value of symbolic reasoning. In particular, the publication of the *Arithmetica Infinitorum* touched off a long-running dispute with Hobbes, who in a series of (deliciously!) acrimonious pamphlets attacked not only Wallis's dubious methods of "induction," but the "scab of Symbols" in general whose "shallow" and self-contained logic, dangerously untethered from the geometric *thing itself*, had produced such evident quantitative impossibilities as a finite value for an infinite series, or a shape infinitely small yet still possessing breadth. "The cause [of] …so much absurdity," Hobbes argues, "I imagine to be this, that he mistook the study of *Symboles* for the study of Geometry," entering a process of circular reasoning "wherein the *Symboles* serve only to make men go faster about, as greater Winde to a Winde-mill."[47] Such symbols may "shorten

the writing," but "they do not make the Reader understand…sooner" anything not previously known: worse yet, as a mode of knowledge-making or discovery, their hidden action necessarily "contend[s] against the common light of Nature."[48]

While the wider debate between Hobbes and Wallis has been ably explored elsewhere, notably by Douglas Jesseph,[49] I should like to pause a moment in closing on this image of the coded space of symbols as dangerously shaded from "the common light of Nature," standing as it does in apparently flat contradiction to Oughtred's praise of the power of symbol to present things directly "to the eye." While Hobbes was by no means alone in his criticism of Wallis's method of indivisibles, the second edition of the *Arithmetica Infinitorum* also includes a letter of strongly positive response from Oughtred himself, who had been presented with an early manuscript by Wallis. In it, Oughtred not only declares his "unspeakable delight" in his old pupil's achievement, but he also aligns both men as part of a common algebraic project of "mysterious inventio[n]" that is, suggestively, *both* shadowed and illuminating—or, perhaps, the more wondrously illuminating by virtue of shining through shadows. In the text of the *Key* itself, Oughtred had recommended that would-be symbolic analysts watch for the crucial, enigmatic moment "when [the] *Aequation*… first begins to shine out of the coverts of the question."[50] Now, in Wallis's work, the older man finds the realization of precisely this moment of symbolic promise: two decades ago, he tells us, he himself had "wrought over again, more agreeably to my way" some geometric theorems of Cavalieri, and "saw" in that act of transcoding "a light breaking out for the discovery of wonders to be revealed to mankind, in this last age of the world." "Which light I did salute as afar off," Oughtred closes, "[I] now at a nearer distance embrace in your prosperous beginnings." The romance of symbolic revelation, then, is one of light "breaking out…afar off," moving "nearer," but still—perhaps necessarily and always—at a "distance." In their faith in the power of the proper code—perfectly regular, mechanically productive, mysteriously oracular in its very occlusion—to *produce* knowledge, and perhaps even to stand in for thought itself, Wallis and Oughtred look forward not only to Leibniz's ambitions for a formal *mathesis universalis* at the end of their century, but also, perhaps, to our own era's ongoing fascination with the "discovery of wonders" in code and computation.[51]

Notes

1 Robert Recorde, *The Whetstone of Witte Whiche Is the Seconde Parte of Arithmetike* (London, 1557), Gg4r.
2 Ibid., Ff1r; William Oughtred, *The Key of the Mathematicks New Forg'd and Filed* (London, Tho. Harper for Rich. Whitaker, 1647), 53.
3 Set d = Dukes, e = Earls, and s = Soldiers. Then the herald's coded message presents the following system of equations:

$$e = 2d$$
$$4d \cdot e = s$$
$$s = 200 \cdot 9d$$

Thus, substituting for s and e,

$$8d^2 = 1800d$$
$$d = 225$$

4 For an excellent introduction to the development of early modern algebra in general, and of symbolic algebra in England in particular, see Jacqueline A Stedall, *A Discourse Concerning Algebra: English Algebra to 1685* (Oxford: Oxford University Press, 2003).
5 An interesting perspective on the early-modern "word problem" as narrative form in general (although, perhaps, without sufficient distinction between arithmetical and geometric forms of the "problem") is provided in Kenneth J Knoespel, "The Narrative Matter of Mathematics: John Dee's Preface to the 'Elements' of Euclid of Megara (1570)," *Philological Quarterly* 66, no. 1 (Winter 1987): 27–46.
6 Jacob Klein, *Greek Mathematical Thought and the Origin of Algebra* (Cambridge, MA: M.I.T. Press, 1968), 70, 150–184.
7 Jens Høyrup, "Hesitating Progress—The Slow Development toward Algebraic Symbolization in Abbacus- and Related Manuscripts, *c.* 1300–*c.* 1550," in *Philosophical Aspects of Symbolic Reasoning in Early Modern Mathematics*, ed. Albrecht Heeffer and Maarten Van Dyck, *Studies in Logic* 26 (London: College Publications, 2010), 3.
8 For a more precise elaboration of formal relationships between "code," message, and information in information theory, see especially Peter Harremoës and Flemming Topsøe, "The Quantitative Theory of Information," in *Philosophy of Information*, ed. Pieter Adriaans and Johan van Benthem (Amsterdam and Boston, MA: North Holland, 2008), 171–172. Within the realm of cognitive arithmetics, Stanislas Dehaene's "Varieties of numerical abilities," *Cognition* 44 (1992): 1–42 provides a good overview of the distinct concept of "code" or "encoding complex" as a mental representation of number. Although research to date has focused more directly on the cognitive function of simple cardinal characters (e.g. Hindu-Arabic figures) than on higher-order mathematical symbolism, the work of Dehaene and others does suggest that symbolic representation in general is importantly bound up in the structuring of human mathematical cognition.
9 Especially helpful are Antoni Malet, "Algebra as Language: Wallis and Condillac on the Nature of Algebra," *Cronos* 5–6 (2002–2003): 5–24; Giovanna Cifoletti, "The Algebraic Art of Discourse: Algebraic Dispositio, Invention and Imitation in Sixteenth-Century France," in *History of Science, History of Text*, ed. Karine Chemla, Boston Studies in Philosophy of Science 238 (Boston, MA: Kluwer Academic, 2004), 123–135; Giovanna Cifoletti, "Mathematics and Rhetoric. Introduction," *Early Science and Medicine* 11, no. 4 (2006): 369–389.
10 John Wallis, *A Treatise of Algebra Both Historical and Practical* (London, 1685), a2v–a3r.
11 Christoph J. Scriba, "The Autobiography of John Wallis, F.R.S.," *Notes and Records of the Royal Society of London* 25, no. 1 (June 1, 1970): 38.
12 David Eugene Smith, "John Wallis as a Cryptographer," *Bulletin of the American Mathematical Society* 24, no. 2 (1917): 88.

13 Helena M. Pycior, *Symbols, Impossible Numbers, and Geometric Entanglements: British Algebra through the Commentaries on Newton's Universal Arithmetick* (Cambridge: Cambridge University Press, 2006), 114.
14 Girolamo Cardano, *De Rerum Varietatis*, quoted in Charles J. Mendelsohn, "Cardan on Cryptography," *Scripta Mathematica* 6, no. 3 (1939): 159; Peter Pesic, "Secrets, Symbols, and Systems: Parallels between Cryptanalysis and Algebra, 1580–1700," *Isis* 88, no. 4 (1997): 681–683.
15 Pesic, "Secrets, Symbols, and Systems," 685–688.
16 William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture* (Princeton, NJ: Princeton University Press, 1994), 275–291.
17 Samuel Morland, *A New Method of Cryptography* (London, 1666), 8.
18 Early modern experimenters with artificial character also shared a common set of logistical challenges in bringing their works to print, given the expense and difficulty of casting novel typefaces. Bright was obliged to confine his book to short runs so that special characters could be written in by hand, and Wallis, a century later, complains of the "disadvantage" in having his *Treatise on Algebra* proofed and printed remotely in London, since no Oxford printers stock the appropriate character set. See Patricia Brewerton, "'"Several Keys to Ope" the Character': The Political and Cultural Significance of Timothy Bright's 'Characterie,'" *The Sixteenth Century Journal* 33, no. 4 (2002): 951; Wallis, *A Treatise of Algebra Both Historical and Practical*, b1v.
19 Jacqueline Stedall, "Symbolism, Combinations, and Visual Imagery in the Mathematics of Thomas Harriot," *Historia Mathematica* 34, no. 4 (November, 2007): 383.
20 Florian Cajori, *William Oughtred, a Great Seventeenth-Century Teacher of Mathematics* (Chicago, IL: Open Court Publishing, 1916), 58–60. In the 1647 *Key of the Mathematicks*, Oughtred provides a scrupulously straightforward and literal translation of the earlier *Clavis*, with only a few minor rearrangements; all references in this essay will be to this later version of the text.
21 Oughtred, *The Key of the Mathematicks New Forg'd and Filed*. The introductory material is not clearly paginated; the passages referenced here are to be found on the first, second, and fourth pages of the address "To the Reader," respectively.
22 Cajori, *William Oughtred, A Great Seventeenth-Century Teacher of Mathematics*, 58–60.
23 Wood, *Athenae Oxonienses*, ed. Philip Bliss (1820), quoted in Cajori 60; Wallis, *A Treatise of Algebra Both Historical and Practical*, 67.
24 Oughtred, *Key of the Mathematicks*, 4.
25 Oughtred, 33. The visual contrast between the plain, italic, and inverted-italic versions of the X and Z is fairly easy to miss in the printed text: Oughtred shares his cryptographer-contemporaries' enthusiasm for delineating important logical distinctions via minute differences in type. For an alternative deployment of italic versus plain typefaces, see John Wilkins, *Mercury, Or, The Secret and Swift Messenger* (London: I. Norton for John Maynard and Timothy Wilkins, 1645), 90–93; and the accompanying discussion in Katherine Ellison, "Millions of Millions of Distinct Orders: Multimodality in Seventeenth-Century Cryptography Manuals," *Book History* 14 (2011): 11ff.
26 Florian Cajori, "The Works of William Oughtred," *The Monist* 25, no. 3 (1915): 446–448.

27 See also additional discussion in Pycior, *Symbols*, 53–54.
28 In its tendency to subordinate even quantitative entity itself to operational process as matter of mathematical investigation, Oughtred's approach here aligns with that of Viète in the 1590s. See Henk J.M. Bos, "Philosophical Challenges from History of Mathematics," in *New Trends in the History and Philosophy of Mathematics*, eds. Tinne Hoff Kjeldsen, Stig Andur Pedersen, and Lise Mariane Sonne-Hansen (Odense M: University Press of Southern Denmark, 2004), 52.
29 For a helpful discussion of the status of cryptography itself as partly mechanical and partly intellectual pursuit, see Katherine Ellison, "Digital Scholarship as Handwork and Brainwork: An Early Modern History of Cryptography," *Journal for Early Modern Cultural Studies* 13, no. 4 (Fall 2013): 31–36.
30 Oughtred, *Key of the Mathematicks*, 54. Similarly, the critically important ninth section of the chapter, dedicated to the solution of quadratic equations ("in which there are Three *Species* ascending in order of the Scale").
31 Albrecht Heeffer provides an excellent discussion on the rise of the *equation* as the critical object of algebraic analysis in his "From the Second Unknown to the Symbolic Equation," in *Philosophical Aspects of Symbolic Reasoning in Early Modern Mathematics*, ed. Albrecht Heeffer and Maarten Van Dyck, Studies in Logic 26 (London: College Publications, 2010), 57–101.
32 Oughtred, *Key of the Mathematicks*, 69.
33 Ibid., 53.
34 Thomas Hobbes, *Six Lessons to the Professors of the Mathematiques* (London: J.M. for Andrew Crook, 1656), 55.
35 Oughtred, *Key of the Mathematicks*, 83.
36 Cajori, *William Oughtred, a Great Seventeenth-Century Teacher of Mathematics*, 13.
37 Girolamo Cardano, *The First Book of Jerome Cardan's De Subtilitate*, trans. Myrtle Marguerite Cass (Williamsport, PA: Bayard Press, 1934), 75 (my italics).
38 Gottfried Wilhelm Leibniz, *New Essays on Human Understanding*, ed. Jonathan Bennett, trans. Peter Remnant (Cambridge: Cambridge University Press, 1981), 455. The *Essays*, written in response to Locke's *Essay Concerning Human Understanding* 1690 and unpublished during Leibniz's lifetime, are structured in the form of a dialogue between a stand-in for Leibniz ("Theophilus") and a version of Locke ("Philalethes"), who quotes extensively from the original *Essay*. The views cited here are those of Theophilus/Leibniz. For details of the composition of the *New Essays*, see Remnant and Bennet's introduction to the *New Essays*, xi–xiii.
39 René Descartes, "Rules for the Direction of the Mind," in *The Philosophical Writings of Descartes*, trans. John Cottingham, Robert Stoothoff, and Dugald Murdoch, vol. 1 (Cambridge: Cambridge University Press, 1985), 35–36.
40 Carlo Ginzburg, "Clues: Roots of an Evidential Paradigm," in *Clues, Myths and The Historical Method* (Baltimore, MD: Johns Hopkins University Press, 1986), 102–103, 117.
41 Eamon, *Science and the Secrets of Nature*, 281–282.
42 Ibid., 288.
43 Galileo, *Il Saggiatore*, quoted in Alexander Murray, *Reason and Society in the Middle Ages* (Oxford: Clarendon Press, 1978), 141.
44 Jacqueline A. Stedall, "Introduction: *The Arithetic of Infinitesimals*," in *The Arithmetic of Infinitesimals: John Wallis 1656*, by John Wallis, ed.

Jacqueline Stedall, trans. Jacqueline A. Stedall (New York: Springer, 2004), xi.

45 Wallis's work with infinitesimals is much indebted to the methods of "indivisibles" developed by Gilles Persone de Roberval, Pierre de Fermat, and Bonaventura Cavalieri, although Wallis himself would likely have encountered these ideas only through reading the 1644 *Opera geometrica* of Torricelli. Wallis himself, however, makes a point of stressing the numerical basis of his methods, deliberately entitling his treatise *Arithmetic of Infinitesimals* to parallel Cavalieri's *Geometry of Indivisibles*. See ibid., xiv–xv; John Wallis, *The Arithmetic of Infinitesimals: John Wallis 1656* (New York: Springer, 2004), 2.

46 Wallis, *The Arithmetic of Infinitesimals*, 13.

47 Hobbes, *Six Lessons to the Professors of the Mathematiques*, A3v. As a radical materialist in geometry, Hobbes is particularly sensitive to the apparent spatial paradox at the heart of many of Wallis's ideas; and while these claims against Wallis are valid enough, Hobbes' insistence on a geometry grounded in the concrete properties of material bodies would eventually lead him to break with much of the tradition of classical geometry, as well. Douglas M. Jesseph gives a wonderfully lucid overview of Hobbes' mathematical ideas in context in "Of Analytics and Indivisibles: Hobbes on the Methods of Modern Mathematics," *Revue D'histoire Des Sciences* 46, no. 2/3 (1993): 153–193.

48 Hobbes, *Six Lessons to the Professors of the Mathematiques*, 54, 13.

49 For an excellent discussion of the competing philosophies of mathematical demonstration at stake in the dispute, see Douglas M. Jesseph, "The 'Merely Mechanical' vs. the 'Scab of Symbols': Seventeenth Century Disputes over the Criteria of Mathematical Rigor," in *Philosophical Aspects of Symbolic Reasoning in Early Modern Mathematics*, ed. Albrecht Heeffer and Maarten Van Dyck (London: College Publications, 2010), 273–288. Jesseph also provides a fuller account of the debate in *Squaring the Circle: The War between Hobbes and Wallis* (Chicago, IL: University of Chicago Press, 2000).

50 Oughtred, *Key of the Mathematicks*, 54.

51 For the aspirations of thinkers in the late seventeenth century and today to ground universal systems of knowledge in the creation of the perfect formal code, see, respectively Jürgen Mittelstrass, "The Philosopher's Conception of Mathesis Universalis from Descartes to Leibniz," *Annals of Science* 36, no. 6 (November, 1979): 593–610; Hans Kamp and Martin Stokhof, "Information in Natural Language," in *Philosophy of Information*, ed. Pieter Adriaans and Johan van Benthem (Amsterdam: North Holland/Elsevier, 2008), 56–57.

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8 Limited by Their Letters

Alphabets, Codes, and Gesture in Seventeenth-Century England

Michael C. Clody

When Francis Bacon calls for further investigation of "transitory Hieroglyphics" in *de Augmentis Scientiarum* (1623), he revitalizes an interest in sign language in a surprising new context.[1] Arising out of a tradition that frequently links gesture, rhetorical delivery, and the possibility of a "natural" or "universal" language, this new consideration of manual signs now finds itself entangled in the seventeenth century's growing discourse of cryptography. In the wake of Bacon, for instance, John Wilkins and John Bulwer attempt to harness gesture for clandestine transmissions. Better known for *An Essay towards a Real Character and a Philosophical Language* (1668), Wilkins's earlier *Mercury, or the Secret Messenger* (1641) charts multiple ways in which things or otherwise non-articulate sounds can be used to transmit secret messages, while Bulwer's *Chirologia* and *Chironomia* (printed together in 1644) impose letters on gestures and bodies, and his later *Philocophus, or the deafe and dumbe mans friend* (1648) becomes the first English tract dedicated to the education of the deaf and mute.

This convergence of sign and cryptography is as productive as it is illustrative of a tension between two different modes of representation. Thinking about sign not only advances the discourse of cryptography; more importantly, it should also be admired when it champions the rights of the deaf and mute, which is particularly the case in Bulwer's later work. Yet the focus on gesture and sign also reveals an interpretative shortcoming in these early modern tracts, which were frequently dedicated to teaching *English* on the hands (through "finger spelling," for instance), rather than honoring the unique nature of sign language.[2] Indeed, this early limitation engages in the type of bias that would forestall the recognition of British Sign—which develops organically from "home sign" and deaf communities rather than scholarly discussions of gesture—as an independent language until 2003. Thus, Bulwer's system of "finger spelling," widely acknowledged as a watershed moment in the history of British sign, should also be seen according to its limited interest in teaching, and encoding, *English*. With this difference in mind, returning to the texts of Bacon, Wilkins, and Bulwer allows us to reconsider gesture's resistance to English letters. In this resistance, we will

also find a deeper tension between two mimetic modes: gestural imitation and discursive representation.

In fact, different breeds of similitude underlie Bacon's example of Periander, who, when

> being consulted with how to preserve a tyranny, bade the messenger follow him, and went into his garden and topped the highest flowers, hinting at the cutting off of the nobility, [and in so doing] he made use of a Hieroglyphic just as much as if he had drawn it on paper. (4:440)[3]

The description of Periander's violent message implicitly conflates gesture, drawing, and writing. Not only does the example suggest that Periander's message can readily be translated into the language in which the question was asked, but Bacon also asserts that he might as well have *drawn* or *written* it ("drawn it on paper"). The blending of these representative modes parallels a lapsing terminology of *de Augmentis*; in one instance, gestures—as "transitory hieroglyphics"—appear to share "some congruity with the notion" ("*ex congruo*"), while they also seem to share similitude "to the thing signified" (4:440). Gesture, that is, now obeys the linguistic logic that Bacon sees running through all of signification (what he calls the "Notes of Things" [4:439]): "for Aristotle says rightly that 'words are the *images* of thoughts and letters are the *images* of words'" (4:439, emphasis added). But does gesture share the same congruity with *words* as it does with *things*, or has gestural similitude been overwritten by the words of discourse? Moreover, if the notion is lettered, as Aristotle's dictum implies, the transfer of similitude to both notion and referent assumes the lettered thought can accurately reflect the world.

Like most Renaissance thinkers, however, Bacon considered the mind an imperfect mirror. Despite the Judeo-Christian model of a divine *Word* that was so often deployed to celebrate the human's presumably exceptional capacity for speech, Renaissance thinkers usually approached human language as somehow fallen. While the Word created man in its image (in a shorthand conflation of John and *Genesis*), the stories of Eden and Babel were read as the historical cause of the disparity amongst human languages and a more general fracture amongst words, natural things, and the Word of God (*Logos*).[4] In Bacon, for instance, the consequence of these "events" was a parallel break between human language and what was often called the Book of Nature, yet he is aware that his natural philosophic project—what he calls the Interpretation of Nature—must occur *within* human language. I have elsewhere argued that Bacon's *Novum Organum* resolves this inability to escape language through a cryptographic reading for what he terms the "Alphabet of Nature," which is written in neither Latin nor English.[5] Bacon's natural philosophic project, that is, points *beyond* the particularities of human

language to a different *type* of image: not man's reflection of the word, but nature's (indexical) "image" of Creation, which he suggestively dubs "the footsteps of the Creator imprinted on his creatures" in *The Great Instauration* (4:33). Bridging this gap between language's representation and the imitations of nature will continue to haunt seventeenth-century discussion of gesture, sign, and cryptography.

In *de Augmentis*, Bacon speaks of "the Organ of Transmission in general" (4:439). He explains:

> For it seems that the art of transmission has some other children besides Words and Letters. This then may be laid down as a rule; that whatever can be divided into differences sufficiently numerous to explain the variety of notions (provided those differences be perceptible to the sense) may be made a vehicle to convey the thoughts of one man to another.
>
> (4:439)

Finding "differences sufficiently numerous" in *anything* could become the grounds of a new signifying system, provided that there are sufficient number of things to represent one's thoughts. The Book of Nature might become the codebook of man, as the world becomes a potential script for cogitations.[6] Bacon finds this art of transmission already practiced by the "deaf and dumb" (4:439), whose language, "older than the very elements of letters," later Baconians will harvest for its cryptographic potential (4:440).[7] For Bacon, despite the prevalence of letters—in spoken, written, and imposed forms—the issue of transitory hieroglyphics remains worthy of consideration because

> we are handling here the currency (so to speak) of things intellectual, and it is not amiss to know that as moneys may be made of other material besides gold and silver, so other Notes of Things may be coined besides words and letters.
>
> (4:440)

The value of the currency, we might say, depends not only on its matter but also on the type of image with which it is stamped. Yet after this statement, Bacon sets aside this discourse as "wanting" (4:440) and leaves us to our own considerations of this "mint of knowledge," as he labels the site of linguistic production in *Of the Advancement of Learning* (3:400). But what *type* of image do those "other children" provide of their creator?

The legacy of Bacon's work with signification and particularly his bilateral cipher can easily be picked out in seventeenth-century English cryptography. Wilkins's *Mercury*, for example, not only employs the bilateral cipher engineered by his predecessor but also nearly duplicates the alphabetic legend *De Augmentis* supplies for its decryption.[8] The

bilateral cipher works by printing in at least two fonts, different enough to be recognized by the interlocutor but subtle enough to be passed over by the unsuspecting reader. By tabulating the font usage across the letters, one could decipher a letter belonging to the secret message that is held within the surface communication; for example, using font "A" and "B" in a pattern of AAAAB across five letters would yield a "B." Thus, as *Mercury* puts it, "Two letters of the Alphabet, being transposed through five places, will yield thirty two differences, and so will more then serve for the foure and twenty letters" (88). Indeed, any sounds with at least two distinguishable tones, including "Trumpets, Bels, Cannons, Drums, &c. or any object of sight, whether flame, smoake, &c. which is capable of a double difference" can encode English messages (131). The bilateral cipher consequently becomes a template for investing a wide range of articulate, inarticulate, and mute signs with alphabetic significance.[9]

The divisions of *Mercury* attend to three methods of clandestine communication: "*Cryptologia*, or the secrecy of speaking" (14); Cryptographia, the secrecy of writing; and Semæologia, which operates "*by signes and gestures*" (111). While most of Wilkins's tract documents the various types of codes employed, it is this last category that presents him with a particularly tricky problem, for *semæologia* includes communication amongst those who could not otherwise speak—and even offers him a glimpse into a possible universal language through which "men of severall Nations" can "entertain a mutuall commerce and traffique" (113). The basis for such a universal language relies, he states, on the natural way that the deaf overcome that which they lack.

> It were a miserable thing, for a rationall soule, to be imprisoned in such a body, as had no way at all to expresse its cogitations: which would be so, in all that are borne deafe, if that which nature denied them, were not in this respect supplied, by a second nature, custome and use.
>
> (114)

Here, Wilkins's focus on "custome and use" rightly points to the *ex placito* or conventional basis of sign, yet in other places, he speaks more broadly about *semæologia* (and, thus, gesture), even when it is practiced by infants—and, therefore for Wilkins, "before" speech (8)—or, in its *ex congruo* form, as it can be shared by men and "dumbe creatures" (111).

In its discussion of *ex placito* signs, *Mercury* returns to how anything can serve as a letter, including parts of the human body.

> Hence it is easie to conceive, how the letters, as well as the numbers, may be thus applyed to the severall parts of the hand, so that a man might with divers touches, make up any sense, that hee hath occasion to discover unto a confederate.
>
> (116–17)

Charles de la Fin's *Sermo Mirabilis*: *Or, This Silent Language* (1696) develops a similar approach to what he terms the "Natural *Alphabet*."[10] In la Fin's system, each vowel rests on a fingertip while the consonants are appropriate to the name for their location; for example, for the English alphabet, the tract provides the following key: B—Brow, C—Cheek, and D—Deaf Ear (See Figure 8.1).[11]

In one sense, the signifiers are "more" material insofar as they are portions of a physical body, but in another, the physical body has been claimed by ciphers.[12] Projecting letters onto bodies alters their directionality; now located within a field of letters and "speaking" to an English ear, these bodies have been filtered through the discourse by which they are now imprinted.

Figure 8.1 Charles de la Fin. *Sermo Mirabilis* (London: Rising Sun in Cornhil, 1696), p. 2: "Natural *Alphabet*." Folger Shakespeare Library Shelfmark: L174. Used by permission of the Folger Shakespeare Library under a Creative Commons Attribution-ShareAlike 4.0 International License.

Practically speaking, *Sermo Mirabilis*'s crude designations are as subtle as a third-base coach, which is probably why Wilkins recommends imposing "significations, upon such actions as are of more common unsuspected use," like rubbing the face or winking (*Mercury* 117). Yet imposing the alphabet on people or gestures is not unique to la Fin and Wilkins, and John Bulwer, also answering Bacon's call to undo Babel by studying "Natures Hieroglyphique," imagines bodily alphabets in *Chirologia* and *Chironomia*.[13] In fact, Bulwer's treatises also rely on the Baconian lesson about differential signifiers,[14] and the two works include four permutations of alphabets assigned to fingers, gestures, hands, and "Rhetoricall INDIGITATIONS" (*Chironomia* 94). In each table, a letter is paired with an image and "ordered to serve for privy cyphers for any secret intimation," thus inviting the reader to practice covert bodily spelling (*Chirologia* 150; see Figure 8.2). As each diagram encodes gestures with alphabetic significance, however, it simultaneously refers to what

Figure 8.2 John Bulwer. *Chirologia* (London: T.H, 1648), pp. 150–151: "An Index of reference to the … Alphabet of natural expressions." Folger Shakespeare Library Shelfmark: B5462. Used by permission of the Folger Shakespeare Library under a Creative Commons Attribution-ShareAlike 4.0 International License.

Bulwer considers a "natural expression." For instance, "I Gesture" (the first gesture described in the treatise) not only denotes "A," but is a "naturall" gesture of supplication where we "*importunate, intreat, request, sue, solicite, beseech,* and *ask mercy and grace* at the Hands of others" (11, my italics indicate a different font in Bulwer's text). The gestural, "natural" meaning arises in tension with its assigned alphabetic value.

Chirologia reads like an encyclopedia of gestures and includes discussions of their meanings as well as an impressive array of classical references. Yet all the images of hands, fingers, and gestures in *Chirologia* and *Chironomia* continuously suggest something that the English alphabet cannot capture. For gestures are, to Bulwer, "natural expressions" that exceed the bonds of any single language, and even the table of gestures in the above figure notes its own "defect of … motion and percussion." Gestures are, in other words, part of what he considers "the only speech and generall language of Humane Nature" and another "ampitheater" of the body (*Chirologia* A6, A7). The text aspires to grant gesture priority; one of the introductory poems declares that "The Tongue and Heart th' intention oft divide: / The *Hand* and Meaning ever are ally'de" (b1), and the quickness of its expression "anticipates the Tongue," a near simultaneity that argues for a physical basis for expression (4). In the simplest terms, the speech of the body appears as an indexical signifier and, at times, a symptom of a physiological state;[15] gesture bears a necessary causal relation to the signified, like smoke to fire in Bulwer's example, or even like footprint to Creator to return to Bacon's suggestive phrasing. But the language of naturality is, as always, slippery, and the logic of *Chironomia* depends upon the fact that gesture can be practiced and mastered, for good or ill. Idolaters, for instance, might falsely raise their hands as if their minds are "erected upwards," but only do so as "Apes" who instead worship "wood and stone," yet despite this duplicitous possibility, the rhetorician's studied control of gesture adds legitimacy and effect (*Chirologia* 21). The cover page of *Chironomia* depicts this tension between acting and saying: the rhetorician, Demosthenes, practices gesture in the mirror under the tutelage of Andronicus, an actor. Meanwhile, Polyhymnia, the muse of eloquence, sacred poetry, *and* pantomime, graces the cover of *Chirologia*. Borrowing from Plato's classic division of two types of mimesis, we can say that the title pages visually confound the dramatic and the narrative, and all in sight of the mirror.[16]

Perhaps the most surprising thing about Bulwer's *Chirologia* is not that it includes an alphabetic legend for reading select gestures but that the body of the text never speaks directly of its own cryptographic potential.[17] Even so, the multiple typefaces of the text suggest that something more is going on. Latin quotations—as well as names and select nouns (like "Hands")—appear italicized *pro forma*; more interestingly, though, each gesture's description is presented in capital letters while its significance appears in a distinct Gothic font (see Figure 8.3).[18]

Innocentium oſtendo. Geſt. XI.

TO IMITATE THE POSTURE OF WASHING THE HANDS BY RUBBING THE BACK OF ONE IN THE HOLLOW OF THE OTHER WITH A KIND OF DETERSIVE MOTION, is a geſture ſometimes uſed by thoſe who would profeſſe their innocency, and declare they hate no Hand in that foule buſineſſe, not ſo much as by their manuall aſſent; as it were aſſuring by that geſture, that they will keepe their Hands undefiled, and would waſh their Hands of it: no, have any thing to doe therein. A geſture very ſignificant, for the *Hands* naturally imply, as it were in Hieroglyphique, mens acts and operations; and that cleanſing motion denotes the cleanneſſe of their actions. As this expreſſion is heightned by the addition of water, 'tis made by the Ægyptians the Hieroglyphique of innocency. In token (alſo) of innocency this geſture was commanded the Elders of the neighbour Cities in caſe of murther. And it was practiſed by *Pilate* when he would have transferred from himſelfe unto the Jewes the guilt of our Saviours blood; who when he ſaw he could not prevaile with the multitude for the delivery of Chriſt, he called for water and waſhed his *Hands*, I am innocent, ſaith hee, of the bloud of this juſt man, looke you to it. To this geſture that of the Pſalmiſt referres, I will waſh my *Hands* in innocency. And from this geſture came the Adage concerning mutuall good offices, *Manus manum, digiti interim digitos lavant.*

Pier. Hieroglyph.

Deut. 21. 6

Mat. 27. 24.

Pſal. 26. 6.

Eraſ. Adag

Figure 8.3 John Bulwer. *Chirologia* (London: T.H, 1648), p. 40. Folger Shakespeare Library Shelfmark: B5462. Used by permission of the Folger Shakespeare Library under a Creative Commons Attribution-ShareAlike 4.0 International License.

While the different fonts of Bacon's cipher call attention to a letter's "bilateral" participation in two distinct messages, their plurality in Bulwer calls attention to the different modalities of meaning for gesture and description. Bulwer's text, that is, announces its own physical dimensions and sets them against the abstract meaning "beyond" the letters. In fact, Thomas Diconson's introductory poem mentions gesture as not only "Natures Hieroglyphique" but also "the grand / And expresse Pantotype of Speech" (a2). While contemporaneous usage of the term "type" does not carry today's denotation of "typeface,"[19] the phrase's play on "pantomime" and its etymological significance (i.e., "pantotype" as "universal form") suggest dramatic possibilities that exceed any single *character* (a term with an etymology rich enough to warrant its own study). The proliferation of typefaces, like the gestures underneath their respective alphabetic charts, strain against the bonds of English lettering, leaving us with what only at first seems a tautological point: that the "universal" language (of gesture) is not exhausted by any particular language (such as English).

"Another *Novum Organum*," *Chirologia*'s promised community partakes in the discourse of humanist dominion and English colonization (b2). As the "*universall character of Reason*" (3), gesture can partake in all scripts but is exhausted by none, opening a communal site that straddles boundaries between human capacities, species, and nations. Infants communicate through gesture; it is also "the common tongue of Beasts, who by gestures declare their senses, and dumb affections" (5). Gesture offers a way for beasts and man to intercommunicate and formulate "a society and communion of justice, fellowship, good wil, and affection betweene us and Brutes" (6). As the "*Tongue and general language of Humane Nature*," gesture remains a method to speak with what Bulwer calls "those salvage Nations" (3). "All Tribes shall now each other understand," and "*Chirologie* redeemes from *Babels* doome, / And is the universall Idiome" (b2). It is difficult to miss the contradiction. Given that, in the broader Western tradition, language is a distinctly human characteristic and the very mark of human dominion, it can never be *universal* in its application to the languages of beasts, and communication across such inter-special bounds potentially upends any model of communication exclusively dependent upon words. Gesture consequently opens a problematic realm of potential that depends on an imitative faculty shared with animals and that the Western tradition deems lesser than speech. What had been considered merely a privation now finds a novel power of communication beyond the limitations of the word.

Perhaps this is what leads to such a unique impasse when Bulwer addresses *Philocophus*'s deaf dedicatee:

> For even your *Privative Qualification* is such, that the extent of our apprehension when it is most excessive, is but able to afford

> an expression thereof[.] [O]ur minde being much put to it to take a nominall scantling of your Quality, and it argues an admirable power in our soule, that is so notable an Engin, that it can raise a positive notion out of privative: For *Deafeness* and *Dumbenesse* being *privations* and *Negatives*, wee can easier say what you cannot doe, then what you can: For, that is beyond our reach, positively to state your abilities, which may be ranked with *honour*, *praise*, and *glory*, which although they have so great an influence upon us; yet wee know not where to finde their subsistance, or a sufficient notion to define them by.[20]

The proficiencies of the Dedicatee have a communal "influence" enabled by a positive emanation from what Bulwer has only been able to consider as a lack ("a positive notion out of privative").[21] Whatever this ability of the dedicatee is, it is proof of a broad capacity of soul that speech cannot capture. A positive privation presents a problem that haunts its mode of being (its "subsistence"), and for which Bulwer finds himself lacking "sufficient notion to define" or name (no "nominall scantling").[22] The problem of the "universal" language of gesture, and its relation to any particular language, is articulated with new clarity: there is no proper word for the capacity of soul that communicates without speech, yet its status as a deprivation is surely lacking.

This nameless force destabilizes the foundation of *Philocophus*, and the text can only investigate its potential through a lettered glass. Bulwer's text decodes and translates, rather than honors, the unique capacity of gesture, offering instead the dream of sensory substitution without a remainder signaled by the work's cover. The strangely simian portraits that line the bottom of the frontispiece call attention to the fourth figure's missing ears, until one is found in his eye; just so, the first portrait has a nose for its mouth, the second a tongue for his nose, and the third his eyes in his ears. All of the senses, a prefatory poem asserts, "have one common Stocke. / … [And] indulgent Nature for each sence / wanting, allowes a double recompence. / How she translates a sence, transplants an Eare / Into the Eye, and makes the Optiques heare" (b1; see Figure 8.4).

Perhaps the most significant element of the plate for the treatise's program, however, is the instrument that extends from the mouth of the kneeling man into the ear of the face that tops the viol's strings. The lips, that is, become an instrument operating under the image of the man—signaling the link between human and speech—that we can hear *and* watch being played. The musician can now be connected to the deaf ear by turning to lipreading: "*ad motum labiorū!*" ("to the motion of the lips!").

Philocophus comes to depend on overwriting the movements of the mouth, and in so doing, inadvertently suggests that speech actually has a gestural basis.[23] While voice might be "the *matter* of *Speech*" (31), its form is "nothing else but locall motions of the parts of the Mouth" (17).

Figure 8.4 John Bulwer. *Philocophus* (London: printed for Humphrey Moseley, 1648): engraved frontispiece. Folger Shakespeare Library Shelfmark: 165–558q. Used by permission of the Folger Shakespeare Library under a Creative Commons Attribution-ShareAlike 4.0 International License.

As such, motions are considered the "*Essence of words*" (19) and, "marshalled like the Alphabets of gesture in our *Chirologia*, [these motions] expresse the very natural Letters themselves" (39). By focusing on the physiological basis of the sound of the letters, Bulwer arrives at a universal alphabet: "the *natural Letters*, in respect whereof all Nations are of *one lip*, as before the confusion of Tongues" (41, original italics). The facial motions—like fonts—can be shared by many languages, and speech becomes "a silent and audible writing" (83). Seeing letters in movement even suggests that the deaf can learn speech *after* they have learned to read lips.

> [S]peech by it selfe signifies all our conceptions, and writing signifies our speech; for, writing to words, is as words to cogitations: Yet this order is not of necessity, that speech must bee learnt first, and afterwards Writing should succeede, to signifie our words; rather then words writing: there being no naturall necessity for it, so that the contrary cannot bee done … so they who are deafe doe best begin at writing.
>
> (82–83)

This method of lipreading, which can "decipher the Characters of Natures Alphabet," finds a surprising name: the "*Anagram*" (A6), and Bulwer's deaf and mute reader will purportedly undergo

> a happy *metamsychoses* or *transmigration* of your senses, that so at least by way of *Anagram* you may enjoy them all: That learning first to write the *Images* of *words*, and to understand the conveyances of a *visible* and *permanent speech*; from that *Hand A.B.C.* you may proceed unto a Lip-Grammar, which may inable you to *heare with your eye, and thence learn to speak with your tongue*.
>
> (A6–B6)

The "anagram" carries serious repercussions; we might say that, though the letters are the same insofar as the phonetic values of a graphic "A" and the form of "A" on the lips are ideally equivalent, the *Word* has changed.[24] Approaching these motions as another font to be read—to read "spellingly" (190)—Bulwer proposes a metempsychosis that effectively translates the soul of meaning; it relies on a new transcendent guarantor that lends words meaning from an abstract plane.[25] *Philocophus* moves the reader from the gesture-like movement that creates speech to a new source, found in an abstract plane somehow distinct from any particular expression ("permanent speech").

We have returned, that is, to the mint of knowledge to find the coins stamped with a different image, one that, according to the Christian theology upon which Bulwer draws, describes a primary "Word" that does not depend upon pronunciation but that nonetheless follows the model of speech. "Tis true," he assures us, that "this *sounding visible image of the mind*, is not the *Originall*, but a *Copie* only of the Mind," and while the "the *inward* Action of *Locution* which evere preceades the *outer* Speech, is *invisible*," the visible outer component displayed on the face functions as the material of his method (14).[26] And, if nothing else, "the secret whisperings of perfidious men" (54), who might mouth without voicing, prove that speech "doth not necessarily require the audible sound of the voyce" (49). Bulwer, we learn, has patiently led us to an account of cogitation that requires neither form nor substance but is nonetheless the "Word."

> Indeed that Word which sounds outwardly, is but the *signe* of that which *appeareth* inwardly, and to that rather doth the name of the Word appertaine: For, that which is *framed and delivered by the Mouth*, is but *Vox Verbi*, and is so called in respect of the other, from which it hath the *Derivation and Apparencie*, and there may be a *Word* (a *Mental one*) without *pronunciation*, but there cannot bee *pronunciation* or any Vocall representation of the Mind by any utterance of Discourse, without a *Word*.
>
> (16)

Discourse depends upon some silent *Word*, and Bulwer returns us to the Augustinian point that the Word is not mediated by the languages of man, despite its dependence upon a model of human speech. To quote at necessary length:

> He indeed, who as St. *Augustin* saith, can understand a *word*, not only before it sound, but also before any Image of the sound there be formed in the Imagination (although our sight at best be imperfect in this kind:) yet he that desires to attain it, must not look upon the *fashion of our words* either as they sound in the eare, or are utter'd by the voyce, or thought upon in silence (for the thoughts if you trie them) can even feign the noise of the *Tongue*. He must passe over all these, and come to that *prime word* of a reasonable creature, *quod nec prolativum est in sono, nec cogitativum in similitudine soni*; but doth exceed all those signes, either externall or internall whereby it is signified, and is begotten of that very Science which remaines in the minde, and remaines truly and properly mentall, and is produced *intellectually* onely, without *Matter* or *Motion*.
>
> (50)

To translate the Latin above: this Word is neither utterable in sound nor capable of being thought under the likeness of sound.[27] In the most peculiar of fashions, we have returned to a positive, but silent, word that precedes, and exceeds, all sound and alphabetic imposition, yet this word nonetheless depends on the assumed priority of human speech for it is, after all, a *word*. Bulwer's proposed metempsychosis brings the deaf and mute within a sonic conception of language and meaning—to, that is, the abstracted *alpha* and *omega* that ground the mystery of Revelation.[28]

Even if that is the philosophical end of *Philocophus*, the threat of gesture still persists through Bulwer's works. Gesture refutes any simple or monolithic notion of representation that underlies Logos—traditionally the multidimensional term that encompasses reason, word, and speaking. This is not only because its motion can contradict intent or convey falsehood, as it does in the case of the idolaters, but also because of the ways gesture participates with a bodily, rather than abstract, origin (it is, after all, part of the body). *Chirologia* explains this in the following way:

> For, the *Hand* being the *Substitute* and *Vicegerent* of the Tongue, in a full, and majestique way of expression, presents the *signifying faculties* of the soule, and the inward discourse of Reason: and as *another Tongue*, which we may justly call the *Spokesman* of the Body, it *speakes* for all the members thereof, denoting their *Suffrages*, and including their *Votes*.
>
> (2)

Not only a substitute for the tongue, the hand now "*speakes*" for both Reason and a bodily plurality, becoming an *acting* democratic representative rather than the spoken dictate of unchallenged majesty.

While Bulwer's *Chironomia* notes that the hand has been called "the Minde of the Body," something other than simply speaking seems to be going on in the hand's motions (24).[29] Accordingly,

> for that those Elegant conceptions that inrich the pregnant Mind, incite the minde by some stratagem of wit, to finde out apt and fit expressions: and while she labours to be free in powring out her hidden treasures, she imprints upon the body the active hints of her most generous conceits, darting her rayes into the body, as light hath emanation from the Sun: which eloquent impressions, a kinde of speech most consonant to the minde, are in the moving of the Hand so neatly wrought and emphatically produced, that the *Hand* many times seems to have conceived the thought.
>
> (23–24)

The passage is rife with references to procreation—"conceptions" and the "labours" of the "Pregnant Mind," and the additional "conception" of the hand—that culminate in a clash of sound and sights ("consonance" and the Sun's light) and letters and gestures (imprints and expressions), recalling the way in which the charts of *Chirologia* pit alphabetic value against the "natural" meanings of gestures. Seemingly outside the mind, conceits—they "inrich the pregnant Mind"—become a motivational force for their own expression ("incite the mind"); they are a silently radiating source that lies behind and before speech or gesture. Described as the light of the emanating Sun, gesture *partakes* in radiating notions (rather than simply putting them in "images"), reminding us of Platonic *mimesis*.

Perhaps this form of participation forever eludes the letters of the cryptographers. The dualism at the base of lettered imposition even suggests that, in some ways, words and imitation are separated not by insufficient description but by a different basis of signification, one abstract and permanent, the other physical and mobile. In this way, though not to be conflated with sign language, gesture's role in the histories of cryptography and the study of sign is to point to the limit of letters.

Notes

1 One can find earlier considerations of sign language in the English tradition, for instance, in the monastic use of rudimentary sign or in Anglo-Saxon practices of visual counting. On these points, see Scott G. Bruce's *Silence and Sign Language in Medieval Monasticism: The Cluniac Tradition c. 900–1200* (New York: Cambridge University Press, 2007) and Nigel Barley's "Two Anglo-Saxon Sign Systems Compared," in *Monastic Sign Languages*,

eds. Jean Umiker-Sebeok and Thomas A. Sebeok (Mouton de Gruyter: New York, 1987). Unless otherwise indicated, all references to Bacon refer to *De Augmentis* and are taken from *The Works of Francis Bacon*, eds. James Spedding, Robert Leslie Ellis, and Douglas Denon Heath, 14 vols. (London: Longmans and Co., 1857–1864; reprint ed., Stuttgart, 1962–63), quoted on vol. 4, 440. All references to Bacon's works will hereafter be cited in text by volume and page.

2 This does not mean all the period's writers did not recognize the difference between sign and English. In 1680, for instance, George Dalgarno declares,

> The deaf man [who, unlike the blind man, cannot learn by hearing the words around him] has no teacher at all: and tho necessity may put him upon contriving, & using a few signs; yet those have no affinity to the Language by which they that are about him do converse amongst themselves.

See *Didascalocophus, Or The Deaf and Dumb Mans Tutor* (Printed at the Theater in Oxford, 1680), qtd. on 3. Dalgarno's position is not without precedent. Leonardo da Vinci calls for learning gesture *from* these communities; for a discussion of da Vinci, along with a helpful overview of the classical and Italian Renaissance discussion of gesture, see Marjorie O'Rourke Boyle, "Deaf Signs, Renaissance Texts," in *Perspectives on Early Modern and Modern Intellectual History*, eds. Joseph Marino and Melinda W. Schlitt (Rochester, NY: University of Rochester Press, 2000), 164–192. For a background on gesture in the period, see Dilwyn Knox, "Ideas on Gesture and Universal Languages *c*. 1550–1650," in *New Perspectives on Renaissance Thought: Essays in the History of Science, Education and Philosophy in Memory of Charles B. Schmitt*, eds. John Henry and Sarah Hutton (London: Duckworth, 1990), 101–136.

3 *cf*. Bacon, *The Advancement of Learning*, 3:400, which omits the figurative comparison with "drawing" the message on paper.

4 A well-known counterexample to this approach to signifiers might be found in the hermetic tradition, which finds in the emblem, for instance, an intrinsic connection with, and sometimes a sympathetic sway over, the object signified. Also relevant is the Renaissance craze for the original language, or their investment in emblems or even Chinese characters as more perfect written expressions. For an excellent overview of the perceived relationship between the divine and human word, see James Bono, *The Word of God and the Languages of Man: Interpreting Nature in Early Modern Science and Medicine*, vol. 1 (Madison: University of Wisconsin Press, 1995).

5 Michael C. Clody, "Deciphering the Language of Nature: Cryptography, Secrecy, and Alterity in Francis Bacon," *Configurations* 19, no. 1 (Winter 2011): 117–142.

6 Toward this end, the natural philosopher will cite the example of "China and the provinces of the furthest East," who write in "*real characters*, not nominal; characters, I mean, which represent neither letters nor words, but things and notions" (4:439, original italics). These "*real characters*" are, as Bacon says, accepted across cultures with different languages, sharing a common basis that thus exceeds the confines of any particular language enough such that "any book written in characters of this kind can be read off by each nation in their own language" (4:439). However, if the "*real characters*" are non-alphabetic by nature, they nonetheless signify by convention ("*ad placitum*"): "Real characters on the other hand have nothing emblematic in them, but are merely surds, no less than the elements of letters themselves, and are only framed *ad placitum*, and silently agreed on by custom" (4:440). Thus, in these communities "a vast multitude of [these

characters] is wanted for writing; for there ought to be as many of them as there are radical words" (4:440).

7 Bacon's exception to historical precedence of hieroglyphic to letters is "perhaps" Hebrew, alluding to an early modern hypothesis that Hebrew is the first language (*DA* 4:440). In *The Advancement of Learning*, Bacon also associates gestural communication with "barbarous people" (3:399).

8 Wilkins claims that "particular ways of discoursing by gestures, are not to be numbred, as being almost of infinite variety, according as the severall fancies of men shal impose significations, upon all such signes or actions, as are capable of sufficient difference" (115); *cf.* 129–130. John Wilkins, *Mercury, or the Secret and Swift Messenger:* Shewing, *How a Man may with* Privacy *and* Speed *communicate his* Thoughts *to a Friend at any Distance* (London: I. Norton, 1641). All references to Wilkins hereafter cited in text. For Bacon's discussion of the bilateral cipher, see 4:444–447; Wilkins's use of his predecessor's legend for the bilateral cipher can be found on p. 88.

9 Even simpler in conception, though not practice, is the coding of a musical scale in which "each Letter of the Alphabet [may] be rendred by a single sound" (141). As in the bilateral cipher, the medium arises to provide an alternate message, for "the words of a Song may be contrived in the tune of it" (143). These insights also lead Wilkins to speculate about a universal language, a concern which he will develop more fully in his *Essay towards a Real Character*, which, fascinatingly, was not initially designed to be spoken. Wilkins's *Mercury* investigates the way in which "inarticulate sounds be contrived for the expression, not of *words* and *letters*, but of *things* and *notions*" and that are sufficient to restore us to before Babel's confusion (143 original emphasis). In other words, Wilkins here sees these tonal variations as not only exceeding English orthography and letters but also as harboring the potential for a universal language.

10 Charles de la Fin, *Sermo Mirabilis: Or, the Silent Language Whereby One may learn perfectly, in the space of six hours, how to impart his Mind to his MISTRESS, or his Friend; in any Language,* English, Latin, French, Dutch, *&c. Tho never so deep and dangerous a SECRET, without the least Noise, Word or Voice; and without the Knowledge of any in COMPANY. Being An ART, kept secret for several Ages in PADUA. And now made Publick* (London: Rising Sun in Cornhil, 1696), quoted on p. 1 (original italics).

11 *Sermo* also provides the same imposition of the alphabet with a Latin key, and it shifts the locations accordingly; thus B—*Brachium*, C—*Cubitus*, and D—*Dentes*.

12 As Bacon puts it, writing "is performed either by the common alphabet (which is used by everybody) or by a secret and private one, agreed upon by particular persons; which they call *ciphers*" (4:444, original italics).

13 John Bulwer, *Chirologia: or the Natural Language of the Hand. Composed of the Speaking Motions, and discoursing Gestures thereof.* Whereunto is added *Chironomia: Or, the Art of Manuall Rhetoricke* (London: T.H, 1648), quoted on *Chirologia*, a2. Citations hereafter provided in text according to the following format, which I have adopted from the printer: "A" refers to the author's dedication and address to the reader, while "a" refers to the dedicatory poems; I have used "b" to indicate references to unnumbered pages amongst the dedicatory poems; thus, a1, b1, a2, b2, a3, etc. Page numbers refer to the body of the text. Both *Chirologia* and *Chironomia* have their own introductory content and are independently paginated.

14 See, for example, *Chirologia*: "Since whatsoever is perceptible unto sense, and capable of a due and fitting difference; hath a naturall competency to expresse the motives and affections of the Minde" (4).

15 On the physiological and medical influence on Bulwer's account of gesture, see Jeffrey Wollock's "John Bulwer (1606–1656) and the Significance of Gesture in 17th-century Theories of Language and Cognition," *Gesture* 2, no. 2 (2002), 227–258, esp. 240–249.
16 I refer to Plato's discussion of *mimesis* in Book III of *Republic*, in *Complete Works*, ed. John M. Cooper (Indianapolis: Hackett Publishing Company, 1997).
17 The closest *Chirologia* gets to acknowledging the cryptographic potential of gesture (outside of the provided charts) is a brief discussion of the efficacy of silent signs in a loud room (8), and one introductory poem describes Bulwer's plan to offer alphabets to the deaf and mute (b1–a2).
18 Unfortunately, not all of these typographic distinctions are preserved in modern reprints; see, for instance, John Bulwer, *Chirologia: or the Natural Language of the Hand and Chironomia: or the Art of Manual Rhetoric*, ed. James W. Cleary (Carbondale: Southern Illinois University Press, 1974), which omits italics for names and nouns and employs a single font throughout.
19 However, a precedent for using "form" for what we would call "font" can be found in Bacon's discussion of the bilateral cipher; see 4:446.
20 John Bulwer, *Philocophus: Or, The Deafe and Dumbe Mans Friend. Exhibiting the Philosophicall verity of that subtile Art, which may inable one with an* observant Eie, *to* Heare *what any man speaks by the moving of his lips. Upon the Same Ground, with the advantage of an Historicall Exemplification, apparently proving, That a Man borne Deafe and Dumbe, may be taught to* Heare *the sound of* words *with his* Eie, *& thence learne to speake with his Tongue* (London: printed for Humphrey Moseley, 1648), B2–A3. Hereafter cited in text.
21 As Bulwer recognizes, this inability has been at the core of the injustices done to those derogatorily termed "dumbe," and the correction of this injustice is a primary purpose of his treatise.
22 Bulwer comes closest to defining that positive negativity as an "*active power* of *discipline* [that] exists in man onely" (111 [incorrectly numbered 101]). In putting discipline at the heart of human nature, however, Bulwer has only imposed a vague model of activity that asserts, rather than explains, the distinction of man; yet, his doing so suggestively directs us to the priority of *acting*.
23 For a fascinating discussion of speech "as a species of gesture," and thus an upsetting of the phonocentric biases of the Western tradition, see Brian Rotman's "The Alphabetic Body," *Parallax* 8, no. 1 (2002): 92–104, quoted on 95.
24 Anagram, according to George Puttenham's *The Art of English Poesy*, eds. Frank Whigham and Wayne Rebhorn (Ithaca, NY: Cornell University Press, 2007) is "the posy transposed, or in one word a transpose … [that] breed[s] one word out of another, not altering any letter nor the number of them, but only transposing of the same" (196)—an enterprise that "altogether standeth upon haphazard" (196). Puttenham also links the anagram to secrecy through its connection with the emblem, which "commonly contain but two or three words of witty sentence or secret conceit till they [be] unfolded or explained by some interpretation" (191, editor's brackets). Bacon describes his cryptographic method working upon similar lines:

> The way to do it is this: First let all the letters of the alphabet be resolved into transpositions of two letters only. For the transposition of two letters through five places will yield thirty-two differences; much more [than] twenty-four, which is the number of letters in our alphabet. (4:445)

25 See Rotman, "Alphabetic," 97–99.
26 Preserving the motions of speech without such a Word leaves Bulwer with a strange mechanical vision, which he locates in the dream of speech in puppets, "insensible creatures," or even a dead body (46). Compare with *Mercury*, which presents a similar vision of a speaking model (134). At stake in these visions is the reduction and imitation of speech *as* motion, which consequently challenges the singularity of man.
27 Augustine, *On the Trinity* in Vol. 1 of *Basic Writings of Saint Augustine*, ed. Whitney J. Oates, 2 vols. (New York: Random House, 1948), 848.
28 The difficulties of the "Word" exceed what I can here address beyond the analogy with language; see, for example, Giorgio Agamben's "The Idea of Language," in *Potentialities*, trans. Daniel Heller-Roazen (Stanford, CA: Stanford University Press, 1990), 39–47:

> The word that is absolutely in the beginning, that is therefore the absolute presupposition, presupposes nothing if not itself; it has nothing before itself that can explain it or reveal it in turn (*there is no word for the word*). … The proper sense of revelation is therefore that all human speech and knowledge has at its root and foundation an openness that infinitely transcends it.
>
> (41)

29 The cover of *Chirologia* similarly ties hand to mouth by focusing on the stream flowing from a mouth *within* the hand (and consequently reflecting the theoretical primacy given to speech).

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9 Deciphering and the Exhaustion of Recombination

Katherine Ellison

In *Magia naturalis* (1558, 1589), Giambattista della Porta instructs readers to write on the corners of the cut leaves of books, so that when the book is closed a message is hidden.[1] Flytraps, too, make good surfaces for sharing secrets. Writing in the folds of the traps ensures that unwanted eavesdroppers will miss the conversation. Feeding messages wrapped in meat to animals guarantees that secrets will stay safe in the bowels until the animal is killed and dissected. Even stones, della Porta notes, can be cut open with flint, and in the center a letter can be placed. The stone can then be welded back together by mixing the stone powder and colophonia. John Wilkins, in *Mercury, or the Secret and Swift Messenger* (1641) also shares narratives about the creative transference of messages baked inside loaves of bread, rolled inside wax candles, and even written on leaves used as bandages for soldiers' wounds or "putrid Ulcers."[2] When recipients cannot be reached by land, expert swimmers can store messages in bladders and disguise themselves as sea monsters. Recalling a story of Jewish fugitives who melted their gold into bullets that they then swallowed, Wilkins imagines a smuggler who wishes to transport Homer's *Iliad* to safety. If he could write in small enough characters, he could hide a full copy in a nutshell and digest it.

Generally, steganographic anecdotes like these have simply been listed as amusing examples to draw the reader into tedious instruction on the more difficult craft of ciphering. Their references are passed on from one manual, textbook, or history to the next, acknowledged as entertaining and intriguing. Seventeenth-century manuals share stories of clever communication that are repeated, almost verbatim, in nineteenth- and twentieth-century surveys of cryptography history. One of the most popular anecdotes is of Histiæus, who sent a secret message to his son-in-law, Aristagoras, by tattooing a slave's head. The slave was instructed to pass enemy lines, find Aristagoras, and request that his head be shaven. Wilkins boasts of the strangeness, yet the practicality and success, of the method.[3] The same story is repeated without variation in the foundational 1898 history by Edward F. Hulme, *Cryptography; or the History, Principles, and Practice of Cipher-Writing* as well as in 1955 in Laurence D. Smith's postwar *Cryptography: The Science of Writing*. Hulme offers

no analysis of the method beyond remarking that life in ancient times must have moved very slowly.[4] Smith notes that the material practice is not to be snubbed; during World War I, many messages were successfully delivered written on soldiers' bodies in invisible ink.

My interest is in the rhetorical appeal of these repeated narratives of materiality and in the ways in which cryptography instruction provided the seventeenth-century discussion of intelligence and the imagination, perhaps most notable in Francis Bacon's *Advancement of Learning* (1605) and *Instauratio Magna* (1620), with terms by which to articulate the "images of men's wits and knowledges."[5] The anecdotes are marketing strategies to build the reputation of cryptography as exciting, but they are also attempts to embed memorable images in their reader's minds, to make visible and material, and thus to provide evidence for and document, what had been hidden and historically unreported. As Gustavus Selenus's *Cryptomenytices et Cryptographiae libri IX* (1624) reports, Heraclitus wore openly, on his flesh, the words "Κόπσων, Κόπσων" or "involve in shadow, make obscure."[6] These material methods of transmitting intelligence illustrate the creativity of recombination and repurposing; books and bodies are manipulated so that their parts serve diverse functions; the familiar is disassembled and recombined to produce something new and only discernible to the senses trained to perceive it. A cabinet is redesigned so that visible drawers, already built to hide away documents, contain additional hidden compartments. Similarly, a book or a sentence can be restructured in ways that bend the conventions of their use, disguising messages in folds or between the lines.

The research for this essay began with three main questions: what is the pedagogy of cryptography? What are the early modern traditions of *teaching* ciphering and deciphering, and what was the place of cryptography within the contemporary critique of scholastic learning? I find that the cryptography manuals of the period, published before and after the Wars of the Three Kingdoms, set out to reenact Francis Bacon's philosophy of the intellect yet, as the discipline's pedagogy progressed, complicated and specified the terms of cognition as multimodal literacy. By multimodality, I refer to the full repertoire of meaning-making resources that humans use to express themselves and understand the communication of others, including but not limited to aural, visual, embodied, spatial, and gestural practices. This pedagogy of multimodality in the manuals sought to materialize intelligence, both as human mental aptitude and as the communication of privileged information, as a measurable, quantifiable, and even visible trait and ability. The anonymous artist who painted the boyhood portrait of Bacon at age 17 wrote in an arc around his subject, "*Si tabula daretur digna animum mallem*" ("as the face as painted is deemed worthy, yet I prefer the mind" or "if one could but paint his mind"). Cryptography promised to fulfill that artist's desire by providing a step-by-step sketch, categorized by ability,

of the brilliant mind at work. Todd Butler examines, in his study of politics and the early modern imagination, traceable representations of "the very act of *thinking*" and demonstrations of "the cognitive processes by which early moderns believed thoughts and actions were formed" and, similarly, I focus on the mental process of creating and solving a cipher as it was pedagogically presented as a visual, material display of mental prowess through, in particular, the acts of recombination and pattern recognition.[7]

Cryptography of the later sixteenth and seventeenth centuries participated in the contemporary debate about scholastic knowledge and the usefulness of natural philosophy, a disputation Steven Shapin details in *The Scientific Revolution* (1996).[8] The discipline demonstrated that in human communication, the mathematical and conclusive could not be decontextualized from the fuzzier discourse of meaning and intent, or the philosophy of the mechanical workings of the natural world. What a ciphered message meant, where it came from, who sent it and why, and how it worked were all cognitive puzzles to be solved with equal attention. If one believes the common characterization of Bacon and other Royal Society members, like Wilkins, as critical of the imagination, one might assume that the teaching of cryptography is about mental control. Certainly, the strict steps of encryption and decryption lend themselves to the view that cryptographers sought to formulize—and formalize—both thinking and communication in their disciplinary version of the scientific method, and that the acts of ciphering and deciphering eliminate the role of the imagination and the passions from decision making. Clearly, their structures and exercises have been replicated in genres like the intelligence test to reveal some mental faculty decontextualized from the emotional, experiential, cultural world of the test-taker.

Yet this is not the discipline that Selenus, Bacon, Wilkins, John Wallis, or Samuel Morland depict in their manuals. As readers work through the steps of encryption and decryption by hand, they are made aware of their own mental processes, speed, creativity, and stamina as visibly evident in and on the page and the body. Deciphering, in particular, is described as a whole-body, multisensory combinatory experience: papers are unfolded, animals are dissected to retrieve digested messages, flesh is touched and shaved, cipher disks are manipulated, curiosity chests are opened, knots are strung, and bells are rung. Selenus emphasizes this complete embodiment in the introduction to his analysis of Johannes Trithemius's *Steganographia*:

> I have not allowed this Elucidation to go forth in fragmentary form, like a limb which, though most elegantly clothed, is nevertheless rent from the body. For I have at the same time produced the whole body, and have shown the links thereby Steganography is skillfully joined to the other limbs of Cryptomenytics and Cryptography.[9]

In his dedicatory poem to Wilkins's *Mercury*, Richard West describes each part of the body as a communicative instrument involved in ciphering and deciphering: the tongue, hands, feet, eyes, and face transmit secrets. Even "Organs turn'd the sense of *Discipline*" (*l.* 68). Deciphering is exhausting—even painful—physical and mental labor that manifests in the body as fatigue, starvation, and anemia. Pedagogically, the teachers—Wilkins, Selenus, Morland, and John Davys as editor of Wallis's manuscript—step in to the instruction to relieve the burden from the reader.[10] Mechanical devices, too, are created and offered to compensate for the bodily limitations that impede the mind's work.

To cipher or decipher means, to early modern cryptographers like Selenus and Royal Society members Bacon, Wilkins, Wallis, and Morland, to make visible what the laboring mind can do. Cryptography is spatial as well as textual, alphabetic, numeric, print, and multimodal. The forms and structures the languages of cryptography may inhabit are many and varied: letters, numbers, books and their diverse material as well as expositional parts (spines, page edges, margins, inks, the content itself), skins, chemicals, sounds, brass and gold, and even smells were used by seventeenth-century cryptographers to communicate the most protected secrets of their time. Blank pages in otherwise unsuspicious books might have an odor that, if examined, would reveal that a cipher had been written in urine. Most of those protected secrets have not been archived; what remains for close reading are the texts that attempted to replicate and teach those experiences. After a brief historical overview of that pedagogical tradition, this chapter is organized in three parts: first, I conceptualize the materialization of the cognitive skills required to decipher, such as pattern recognition and recombination, and the implications of that materialization; second, I look closely at the rhetorical framework of the manuals as they present the mental work of deciphering in the terms of observable, physical, multisensory labor, and third, I survey some of these multisensory instructional exercises and examples and the mechanical means by which cryptographers attempted to extend the capabilities of the human interface.

Hulme notes that it is "during the stormy closing years of the reign of Charles I" that "we find this art of secret writing assiduously cultivated both by Royalist and Parliamentarian, as the multitudinous records preserved in the British Museum and our other national archives abundantly testify."[11] Hulme is referencing not only collections of ciphered letters that could apparently be found in the British Museum in 1898 but also the seventeenth-century pedagogical tradition that saw increased popularity as a subject of study during and after the turn of the twentieth century. This cultivation took place most publicly in instructional manuals published, in most cases, for a broad, nonspecialist audience, though specialists are also referenced. The introduction to this collection outlines the main textual tradition, from Abu Yùsuf Ya'kùb

Ibn Ishâq al Kindi to Cicco Simonetta and Roger Bacon, Trithemius, Girolamo Cardano, Selenus, della Porta, Francis Bacon, Wilkins, Noah Bridges, John Falconer, etc. Here, I will note the basic structure of the seventeenth-century manuals and examples of the types of exercises they contain.[12] Though their conventions vary, most of the instruction begins with apologies to the reader for errors or the author's shortcomings, as was typical in technical writing of the period. Authors also cited current or recent events in different degrees of specificity depending upon urgency or the political danger of doing so; writing in 1641 after the dissolution of Star Chamber and in the midst of significant change, Wilkins's references are careful, while Morland clearly addresses his 1666 manual to Charles II, and Falconer, in 1685, is clear as well about his political allegiance and motives. The manuals then gloss biblical and historical instances of steganography, cryptography, and sometimes stenography to establish the influence of secret writing traditions on the outcomes of military and government campaigns, as well as provide theological justification for a practice that Royal Society authors like Wilkins were attempting to disassociate from the occult and establish as a legitimate scientific discipline. Finally, the manuals move to exercises in ciphering that proceed from simple monoalphabetic substitution to increasingly more difficult methods.[13] Many include tedious letter frequency charts, grids and diagrams that outline correspondences, and illustrations of more creative multimodal or mechanically-assisted ciphering strategies. Deciphering is typically not the main subject of the genre, with exceptions like Davys's edition of Wallis's methods, with the implied (and problematic) assumption that knowledge of ciphering allows one to also master deciphering.

Of particular interest in the seventeenth-century manuals is the foregrounding of theories of materiality and the functions of the senses in human communication. Wilkins begins his manual with contemplation of the material and immaterial worlds. Angels, he notes, because they are made of a homogenous spiritual substance, communicate as a whole body, and when theologians speak of the "tongues" of angels, they are speaking only metaphorically. The material world of men and women requires instrumentation and the body as tool—the ear and tongue in speaking, the hands and eyes in writing. Yet, communicating is still a whole-body experience even for the corporeal. Every part of the body sends and receives messages, from the feet to the eyelids. Wilkins argues that learning to use these instruments of the full body, and the tools that humans invent to supplement and improve those instruments, is natural and in no way inhibits a person from still exercising instinct or innate abilities. This may seem like a small point, but it is important that Wilkins emphasizes it early in his pedagogy. Here, he articulates his worldview that the material makes visible and is an extension of the immaterial, that words and language provide a window to the intellect.

He also, in just a few pages and without ever naming them (except when he notes that "languages are so farre naturall unto us, as other arts and sciences"), theologically legitimizes science and technology.[14] When cultures do not share that understanding, he points out, the consequences are oppression, colonization, and enslavement. He uses the example of the "late discovered *Americans*, who were amazed to see men converse with books, and could scarce make themselves beleeve that a paper should speake."[15] In his view, the indigenous peoples of America could not grasp the ways in which the intellect can be materialized on paper and read with the eyes, even though they may share an understanding of the symbolic nature of images like paintings or amulets. Wilkins concludes that educating native cultures is not as simple as teaching them the colonizer's language (his goal is not altruistic; he does not seek for the colonized to understand the language of the colonizer); an alternative mode of communication—a trade language—is needed that allows them to make visible their intellect and understand their oppressors so that they can engage in successful economic transactions for the benefit of England. Writing before his detailed description of a universal language in *An Essay Towards a Real Character, and a Philosophical Language* (1668), Wilkins promotes cipher as the solution for cultural difference and for miscommunication in contemporary politics.[16]

I attend to these goals in other scholarship on early modern cryptography; here, my interest is in the specific ways in which cryptographers collectively envisioned ciphering and deciphering as the materialization of human intelligence.[17] In these manuals, cryptography is a generative cognitive practice. As Richard West writes in his dedicatory poem to Wilkins's *Mercury*:

> Your Pen alone *Creates*
> New necessary Sciences; This Art
> Lay undiscover'd as the Worlds fift part.
> But *Secrecie's* now Published; You reveal/
> By Demonstration how wee may Conceal.
>
> (*ll* 8–12)

West legitimizes cryptography as a science as well as an art, ranking it as important as the four elements. In his hyperbolized description—his purpose is obviously marketing the manual and the discipline to consumers—cryptography makes visible and *demonstrates* what readers typically cannot see. Just as wine intoxicates its subject and prompts confession and boasting, revealing hidden secrets, he continues in his verse, cryptography betrays "Great State-affaires," exposing kings and noblemen. West claims that *Mercury* will serve those very state officials by allowing them to finally protect their letters: "now they shall no more *Seale* their own *Fall*;/ No Letters prove *Killing*, or *Capitall*" (*ll* 25–26).

Connecting ciphering to the material tools of writing—ink, quill, and wax—West argues that instruction in cryptography will ensure that secrets do not turn "to bloud" (*l* 21). Wilkins's pedagogy, West points out, allows readers to witness secrecy at work and, in the process, also documents the workings of the mind of the cryptographer.

Central in this practical vision is the combination and recombination of letters and symbols—the moving around of already familiar alphabetic or symbolic characters using patterns. Combination, recombination, and substitution during ciphering, and the pattern recognition required to identify those practices during deciphering, are plotted in the manuals in such a way that they allow the reader to witness how decisions are made. As Sean Silver has found recently, in the eighteenth century, human cognition was represented by informational tasks like collection, cataloguing, and classification.[18] Cryptography provides a case study in how that representation was built over time before the eighteenth century.

The Combinatory Impulse

In Bacon's cognitive model in *De Augmentis Scientiarum* (1623), the senses gather information from the world, which is stored in the memory.[19] The imagination then translates that disorganized information as images that can be stored, arranged, categorized, and used for tasks by reason. Imagination steps in again to communicate reason's conclusions to the will, so that the imagination is responsible both for persuasion—how it interprets stored sensory information and influences what reason wants to do with it—and for motion, since the will and the body can only move, or act, because of the imagination's mediation. Bacon's description of cryptography is of an imaginative act: through the senses, the mind files the disorganized jumble of letters, and the imagination plots the patterns, connections, and combinations that reason can read as plaintext. Butler finds that in Bacon's work, "it becomes increasingly clear that the combinatory impulse plays a crucial role in the progress of human learning."[20]

The most straightforward type of alphabetic recombination is the anagram, but cryptographers note immediately that anagrams, in which letters are simply scrambled, are not ciphers. Anagrams can be recombined to yield more than one alternative message, whereas ciphers must follow a particular series of steps that may include not only alphabetic substitution and rearrangement but also the use of nonalphabetic characters, new types of spatial orientations in reading (reading in a spiral rather than linearly, for example), and other physical manipulations. For example, the most controversial moment in book three of Trithemius's *Steganographia*, which Selenus explains in *Cryptomenytics*, concerns the summoning of angels to deliver encrypted messages. One must use

an incantation, which is itself a cipher, repeating the words on a chart four times in a particular order moving toward the center of a circle. If the combination is correct, and if the speaker "revolve[s] the secret most intently in your mind," the pen will begin to create a melody even if the writer is not a musician, and the angel will respond.[21] This exercise involves simultaneous writing, song, movement, and diagrammatic visualization. The multimodality of the instruction, in fact, is largely responsible for its dismissal by Trithemius's contemporaries as dark magic. Selenus's seventeenth-century position, however, allows him to more critically examine the instruction and acknowledge the multimodal combinatory impulse that makes it effective. Wilkins acknowledges Trithemius's contribution and seems to indicate that the incantation is itself a secret message for expert readers. Selenus indicates, too, that his thinking through of Trithemius's own reasoning process is a means of exposing the minds of both the past cryptographer and the current one, through which the reader can then vicariously experience the delight of discovering what had been hidden and obscure. While readers "enjoy the fruit of my toil," they will become more skillful analysts and students of history, less likely to assume the uncanny or magical in practices that require intellectual labor.[22]

John Locke had famously visualized the mind as a storehouse and theorized, in *Essay Concerning Human Understanding* (1671), that knowledge is produced from the comparison, examination, and recombination of ideas. Twenty years earlier in 1650, Athanasius Kircher provided a vision of the combinatory impulse in a series of diagrams of machines that resembled storehouses. Though Kircher's own contribution to cryptography was minor—he dabbled in polyalphabetic substitution ciphers and numeric ciphers in *Polygraphia Nova et Vniversalis ex Combinatoria Arte Detecta* (1663) —his earlier illustrations of the 1650s look strikingly like the cross sections of cipher devices like the World War II German Enigma.[23] Most interesting was his idea for an augmented, automatic music machine that recombines sounds using cassettes that can be rearranged in compartments. This combinatorial compositional aid would not only play but *generate* an infinite arrangement of sounds. Kircher's student, cryptographer P. Gasparis Schotti (also, Gaspar Schott), would then modify that musical cabinet for secret communication in *Schola Steganographica* (1680) (see Figure 9.1).[24]

Credited as one of the first computers and resembling a typographer's case, the box stores data inputs. In the slots, one slides wooden sticks that contain sets of substitutions for letters and numbers to create almost limitless permutations. The slides can be inserted and removed with great speed, if necessary, perhaps reminding one today of switchboard operators at early twentieth-century telephone companies. One of the key principles of encrypted data storage is that the size of the container—whether it is a box, a file, etc.—remains the same, compressing the

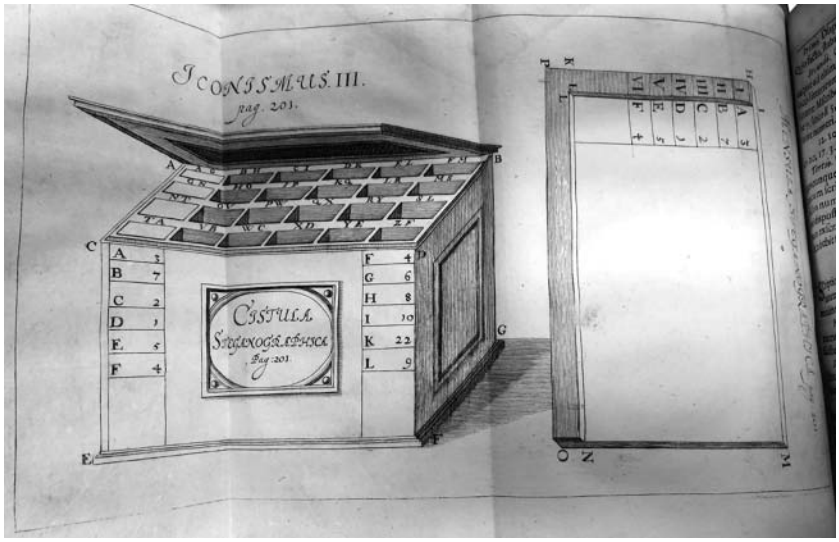

Figure 9.1 P. Gasparis Schotti's illustration of a combinatorial box for secret writing in *Schola Steganographica* (1680). Courtesy of the National Cryptologic Museum.

expanding information so that it can be transferred without suspicion. Redundancy must be eliminated, yet possible combinations maximized, so that a transfer can be reduced to the greatest extent possible without loss of meaning. If the box does not broadcast its purpose as a "Cistula Steganographica" on the face, it can also itself be disguised to look like a snuff or jewelry box placed indiscreetly, and fashionably, on a desk. The device also requires both the manipulation of its removable, changeable parts—not to mention the craftsmanship to build the device and its puzzle-like parts to begin with—and interaction between its material form and paper or other surfaces against which the slides must be placed. The body and mind work together in a series of steps that physically simulate the thought process multimodally.

Schotti's box is not unique in its emphasis on the combinatory impulse as central in cryptography training. Even without the three-dimensional accompanying object, elaborate tables of letter frequencies can also be seen in several manuals even earlier in the genre's tradition. Leon Battista Alberti's *De Componendis Cifris* (1467) provides one of the most extensive meditations, outlining all of the relative orders of and relations between letters so that, if simple monoalphabetic substitution is used, the repetitions, patterns, and positions of particular letters will indicate where the vowels are.[25] And once vowels are revealed, consonants often fall into place easily. Bernard Ycart credits Alberti with providing

"the first example of a quantified stylistic difference ever."[26] Cicco Simonetta also discussed vowel/consonant patterns, as did François Viète, Falconer, Christian Breithaupt, and Philip Thicknesse. Ycart's work on frequency analysis is thorough, and he notes that this kind of pattern recognition only works on the simplest types of ciphers, which one would think would be rarely used. Yet, monoalphabetic substitution ciphers *were* consistently used in the seventeenth, eighteenth, nineteenth, and even twentieth centuries, as Ycart notes. I would add that this mode of pattern recognition—and the type of mind-body data manipulation imagined through Schotti's chest—became popularized as perhaps *the* sign of talent and intelligence in deciphering. The steps promote the abilities associated with the brilliant mind at work: the meticulous, time-consuming charting of multiple languages' structures, calculations for frequency, memorization for fast application (the mind as computer), and the manipulation and rearrangement of letters in new orders to reveal intelligible messages.

William T. Lynch finds, in the Royal Society's interest in "things" over words, that "things 'in themselves' represent an alphabet of hidden powers that can combine in numerous ways to produce the ordinary objects of one everyday experience."[27] "It is from the endless combination of letters into words that we must look to understand nature's works," Lynch notes. Understanding the true form of a letter, he explains—its visual shape, the sound it makes—is easier than understanding a full word, and to comprehend the word, one must attend to the letters. In this way, Lynch finds, letters and their powers of recombination "are more real than everyday objects since everyday objects are composed out of them."[28] Anthony Grafton finds, too, that this recombination, or re-assemblage, characterized the early modern approach to knowledge making. Scientists of the seventeenth century, in particular, "saw their duty not as discovering facts never before seen and drawing references from them but as assembling facts from reliable sources in a new and revealing order."[29] Selenus dedicates many chapters to the various ways one can assemble letters, syllables, and words. "We have gradually advanced from letters to syllables, to close at length in words," he writes at the beginning of a sixth chapter on word position. These "secret processes," he notes, "take place by Interruption of Order, or by Interchange or by Notation of Words. We interrupt Order by scattering whole words or by writing backward scattered words, or by superinducing on words other, Non-significant, words."[30] He provides an example:

> Aser Osaslef Ynoux Aneyerdi Aniek Aneruabs Idnus Ahcise Gremazlesa Psade Inedrows Ed(l?)niky Otlewu Ohconnedt Osniatipaca Peihlap Ulhafe Oseneir Leiso Eruze Ethcarbegk Ohcand Sbiewy Amig Etahu Unegarteguzy Anedy Anednutsa Asegidnebely Stegruwres Unebegebi Enier.

Selenus does not provide the solution for this cipher. He only points out that it is written using scattering, backward writing, superinduction at both the beginning and at the end, perhaps with a vowel or with a consonant, as the German language, because so many of its endings are the same, resists superinduction of full words. It also uses non-significant words and superinduced non-significant letters. The sentence thus demonstrates three categories of superinduction: common, recondite, and mediate. Early ciphering had certainly used similar methods, as this volume of essays testifies; however, the enthusiasm that Selenus expresses for this fever of recombination at the level of the letter, syllable, and word, as well as when using devices that can more easily and quickly orchestrate that rearrangement, is unique to these decades of the seventeenth century, as Grafton and Lynch note.

If early modern cryptography instruction focused only on the recombination of alphabetic or numeric communication to transmit secrets, this essay could stop here and simply argue that the discipline embraced the contemporary interest in cognition as the assemblage of existing things and ideas. Yet, the implications of this confidence in the material demonstration of intelligence extend beyond instruction in word order and point to the larger impact that cryptography would have on what it meant to be literate in the world of the seventeenth century. Grafton cites Galileo Galilei's *The Assayer* (1623) and the moment at which Galilei describes nature as "an encrypted text which only virtuous mathematicians—the prophets of Galileo's time—could decipher."[31] Whether or not *only* mathematicians can have access to the literacy practices of cryptography is debatable, since the instructional manuals are accessible to nonspecialists and posit a world in which even nonacademics can learn to decipher the world through hard work and a widened observational field. Perhaps one of the most memorable visual examples of this process of discovery—of the world and of the self—through assemblage of existing ideas and familiar knowledge is the encrypted image Selenus includes in his memorial to Trithemius in *Cryptomenytices* (see Figure 9.2). This image follows a series of tedious lessons open to diverse readers as well as discussion of Blaise de Vigenère, who embedded ciphers in illustrations of the moon, and "Walch's" later claim to have invented the method of hiding secret messages in natural scenes. "Walch" refers to Johannes Walchius, who authored a collection on fables.[32] Selenus, who is aware that illustrated ciphers had been in use for centuries, records Walchius's inaccurate claim that this method is "the product of my own genius" and "has never been seen by anyone." "I here present it to you visibly," Walchius writes, "that you may, exercising your genius, examine the thing, and, constructing something like it, have inscribed and [sic] figures on the wall of your house the argument of some subject, disguised in similar outlines to these."[33] While Walchius includes a hunting scene, Selenus prefers the pastoral in Figure 9.2.

Figure 9.2 A detailed ciphered image in Gustavus Selenus's *Cryptomenytices et Cryptographiae Libri IX* (1624). Courtesy of the National Cryptologic Museum.

Selenus uses this illustration as a cumulative exercise for the student who has just worked through numerous examples of ciphers using rays, lines of various textures and styles, gestures, and even the raised or lowered necks and hooves of horses. In a kind of final exam, readers are challenged to notice the sheer volume of ciphers that could possibly be before them in a work of art or, even, out in the world in an everyday landscape. His subject is "complete," he notes,

> in the scope of a single scheme, expressing the key and the hidden principle of a great cryptographic device, a scene wherein all these things are present,—where, namely, the eyes of the fruit of the trees, the eyes of the stars and the larger heavenly bodies, of men and animals and birds, are eloquent with meaning.[34]

The illustration stresses the existence of ciphers in nature. The inhabitants of this image are surrounded by ciphers and are also ciphers themselves. From the top to the bottom, readers see birds with wings and feet outspread in shapes that indicate meaning; fruits positioned in a tree that may align with a alphabetic key; windows in distant buildings that remind readers of other illustrations in the manuals that use open and closed, dark and light windows as signals. The people in the illustration are all moving, bending, and gesturing toward and away from the viewer and one another. Tools are crossed, a cow and a horse raise their hooves in mid-step. A mother holds her children, an index finger outstretched, while a man nearby drinks from a bladder in a possible ciphered gesture. And across the full scene itself, almost everyone is busy, laboring, with the exception of a man lounging in the field taking a break and an undressed child looking bored as his mother milks a cow. The illustration shows the extent to which the multimodality of cryptographic literacy extends into the reader's everyday life, creating an augmented reality in which the deciphering mind must be constantly at work even when observing a lovely picture or laboring in the fields.

Recognition of patterns and the ability to reassemble images, sounds, or characters to create new meanings, like those in Schotti's box and Selenus's illustration, required openness to novelty. Wilkins is clear, in *The Discovery of a New World; or, a Discourse Tending to Prove, That (It Is Probable) There May Be Another Habitable World in the Moon* (1638), that openness to new knowledge and to the reorganization of existing knowledge to find new truths is a philosophical as well as political and social imperative for his generation.[35] In *Mercury*, too, his project is to assert the existence of alternative paradigms ignored or unrecognized in the history of human communication. The beginning of *Mercury* explains the historical impact of ciphered messages in past conflicts, and Wilkins is careful to distinguish between stories that were most likely embellished and those that were probable. His project, as he describes it, is to separate the true from the untrue. This distinction aligns with his support for what Shapin calls "ontological openness" and for the respect due to ancient innovators and thinkers when their achievements are logically believable (in contrast to dismissing all ancient knowledge simply because it is old).[36] This is an important point for Wilkins: he advocated for the liberal pursuit of new knowledge through experimentation and observation of the living world of the present, for the advancement of existing knowledge through the recombination of known and probable truths to form new and more accurate ones, and for acceptance of ancient knowledge, if it is probable, on trust. This moderation within the ancient-modern debate and this mediating stance on ancient, scholastic, and popular knowledge is common amongst early modern thinkers who worked in cryptography.

The Royal Society's motto, *Nullius in verba* ("take nobody's word for it"), then, does not fully characterize the philosophies of knowledge at work in the early modern discipline of cryptography. Yet, the act of deciphering, in particular, appealed to a generation hungry for authentication and verification. As Lynch points out, "professionalized research, with its commitment to overcoming individual and group differences between researchers, led to an emphasis on the communicability and testability of knowledge that belied any need for a logic of discovery."[37] Here was a type of communication that held the promise of complete validation: a cipher, it seemed, could only be solved or unsolved, correct or incorrect. One or more series of steps, if followed accurately, would lead to a meaningful outcome. That the plaintext might itself be interpretively fuzzy is not discussed in the pedagogical manuals. The manuals never explain how to interpret plaintext: their job is simply to lead a reader from the cipher to the solution, implying that the plaintext will always be interpretively simple. When a manual's steps toward plaintext could not be verified, they were suspect. The third book of Trithemius's *Steganographia*, as I noted earlier, was accused of promoting black magic because its method, which has since been proven to be verifiable, could not be followed easily to conclusion. Yet, practicing cryptographers were honest about the complexities of verifiability. In his brief *New Method*, Morland notes that verification of a complex cipher cannot be accomplished simply with hard work and an allegedly genius level talent. It is impossible, he stresses, for an eavesdropper who is not privy to the full sequence of directions to decipher sophisticated innovations. He provides numerous diagrams to lead the reader through his own method because he knows that "***Examples*** edifie the Reader much better than bare Words," but if one misses even one of those directions, the solution will not be possible.[38] Even if a reader has almost all of the information necessary to decipher his hidden message, from the original language to the geometric shape to the direction of the writing and the number of columns and lines in which the solution should appear, even a mechanical "Analytick device" will not penetrate its obscurity. In a sarcastic aside for Trithemius's audience, he notes that the only way to verify a cipher for which one does not have full information is "by the *Black Art,* or else an *Angel* from *Heaven*, in kindness, reveal it to him."[39]

Shapin notes that this "degree of ontological openness was the mark of the free man as well as the wise man."[40] Though it may not have been Wilkins's or Morland's intents, the pedagogical cryptography manuals provide such a compelling case study of the material process of knowledge making as puzzle solving that this very process becomes a model for smart thinking. Intellectual history scholars, including W.I.B. Beveridge, Denise Shekerjian, and Darrin M. McMahon, have agreed that what has culturally defined intelligence, the imagination, and even genius is the ability to make visible what is hidden and to see connections

where others cannot see them.[41] Paul Rand, late twentieth- and early twenty-first-century graphic designer and entrepreneur, is quoted often on the internet, in the news, and in various media outlets as an authority on genius for a particular statement that appears in his manifesto of art, *From Lascaux to Brooklyn* (1996): "The role of the imagination is to create new meanings and to discover connections that, even if obvious, seem to escape detection. Imagination begins with intuition, not intellect."[42] Rand promotes the idea that creative genius is *combinatorial*, or the ability to see patterns across objects, cultures, graphic fields, and disciplines and then reveal those patterns to others through recombination. This is an intuitive, not intellectual, skill, he emphasizes. Rand implies that by intuition he means an innate understanding, an observational method that sees "things in a way that is unexpected" that cannot be taught and that might even be instantaneous, while the intellectual is the book-learned, closed mental work that is bounded by the territorialization of training, cultural narrowness, and disciplinarity. He follows this argument for intuition by hastily contrasting a decontextualized seventeenth-century thinker with Albert Einstein: "'Knowledge is power,' said Hobbes; 'Imagination is more powerful,' was Einstein's rejoinder.'"[43] Putting the rhetorical and historical problems with Rand's juxtaposition aside (one cannot simplify Hobbes's philosophy of knowledge in this way), I use this example to illustrate how the contemporary discourse of intelligence centralizes pattern recognition and suggest that the cryptography manuals of Hobbes's own time (and other publications of the new sciences, outside of the scope of this essay) create the rhetorical foundation for this assumption.

Mental Exhaustion

One of the hallmark signs, rhetorically, of the superior cognitive work required to solve ciphers is the mental exhaustion that it causes. Cryptography is not the first discipline to be described as mentally exhausting, but the physical strain of the combinatory impulse is central in seventeenth-century instruction in deciphering as well as eighteenth-century accounts like John Davys's edited publication of John Wallis's manuscript. One does not only use the mind to solve a cipher—one uses the entire body, pushing it to the limits of concentration, missing meals and sleep, depriving it of sunlight and company. Selenus explains that:

> now when I first turned my attention in this direction, this Elucidation cost me the most severe and persistent mental application through a number of years, as also no small expenditure of strength. For I found myself in need of guidance in a veritable labyrinth of Daedalus, or of the Minotaur, that is, of imaginary spirits, and this fact more than the enigmatic incantations, caused me inextricable trouble.[44]

This work of proving that Trithemius was an expert cryptographer and not a fraud, that he had developed a working cipher that was disguised as an occult farce, is intellectually exhausting for Selenus. It is also physically draining, a quest as demanding as a mythological battle with monsters. Through his persistence over the course of many years, though, the burden is off the shoulders of the reader.[45] Selenus deters readers from thinking that his manual is enigmatic, or hiding meanings or "inner secrets," even though he admits that the subject itself is about hiding.[46] He points to Trithemius's warning that authors should not too explicitly reveal the secrets of the discipline, or the "Eleusinian rites," or else be cursed, and to Heraclitus, Plato, and Aristotle's advice that the general public not be privy to learned ideas. Yet, he explains, knowledge of cryptography has always become public, and that publicity has proven a benefit for both contemporaries and future generations. He laments the knowledge that would have been lost had Plato's *Republic* not been accessible and thanks past philosophers for "lift[ing] the cloud" and "point[ing] out to us the light."[47] He also notes that while his instruction is comprehensive and explains the foundational methods of the discipline, his manual cannot be used to sabotage contemporary political, military, or commercial business. Students should expect, as they do in any class, that what they will be taught is only a starting point, and further self-education is necessary to expand upon the basic methods to develop strategies more secure. In this way, his manual is an intellectual as well as physical primer, a series of strength conditioning exercises. Readers must still put in the independent hard work necessary for mastery.

Wallis likewise documents the mental labor of deciphering. His first exercise was leisurely: a colleague showed him a ciphered letter during dinner, and Wallis, intrigued, took it to his quarters and solved it easily within a few hours before sleeping.[48] Though this was an interesting experience for him, he did not feel compelled to challenge himself and quickly dismissed more sophisticated ciphers as impossible. He was then urged to decipher a letter from Secretary Windebank to his son, which Wallis was informed contained "Matters of Consequence." After refusing to "meddle" with it because it appeared unsolvable, Wallis was "by Importunity prevailed with to attempt it."[49] The cipher contained almost 800 characters, and it was so "hard a Task" that he had to take frequent breaks and experience mental "Paines" that are beyond his ability to describe in his memoir.[50]

Selenus comforts the reader who does not want to expend mental effort to solve the ciphers. Thanks to his pedagogy, readers can use "only a slight amount of labor." "But all this I gladly went through, for the public behoof and the reader's good," he writes,

> For I saw that, by this work of mine, other men's thoughts on this subject,—thoughts, most ingenious, which this generation, which is

> fatally bent on producing all subjects, even the most abstruse, has presented to the public in writing,—were also, either illustrated, or at least enriched by no slight accession.[51]

In this way, then, Selenus can appear to shift the burden of learning from student to teacher, engaging in a pedagogy of comfort in which the educator's function is to make learning easy, even pleasant. Like Selenus, Davys mediates the reader's work. In his edition of Wallis's papers, which includes several ciphers deposited at the Bodleian Library, Davys evaluates the ciphers briefly according to which will require more or less labor, in a sense holding readers by the hand as they proceed. A cipher on page 133 is old and known to "Schoole boys" but still challenging, ones on 211 and 214 are not too hard. Another appears more difficult than it is if one does not know that it is actually not in cipher but in shorthand, which took him just a few hours research to discover. Ciphers on page 213 contain only a single alphabet, and pages 198 and 200 are complicated by nulls but still relatively solvable. The rest, he warns, are most likely beyond the skill of most beside himself. On those and other ciphers not included that only he could solve during the wars, most would "loose their Labour."[52] Note here that he does not say that the average readers will lose their *minds*—the mind is one with the labor of the body.

The cryptography instruction of Selenus, Wallis, and Bacon's generation supports the argument about the early modern mind-body relationship that Butler has recently outlined in *Imagination and Politics in Seventeenth-Century England* (2008). Butler notes that the period's mind-body relationship has erroneously been read—and even has been stereotyped—as a competition. "Especially in our post-Cartesian world of mind-body division," he stresses, "there is much value in remembering that for the early moderns body, mind, and soul were less rather than more distinct, bound tightly together and dependent on each other."[53] Gail Kern Paster, too, finds in *Humoring the Body* (2010) that the mind and the passions were seen to operate as "transactional."[54] Countering arguments that Bacon clearly follows the Aristotelian idea of reason as absolute ruler of the mind and its emotions and of the body as governed by the soul, Butler describes the early modern psychology of cognition, for example, as a "fluid mental picture" in which there is a nonhierarchical, balanced relationship between the faculties of mind and body. Davy's depiction of Wallis is of a thinker with a fluid intelligence that involves the body as much as the mind. His image of this genius decipherer is of a fatigued recluse who vanishes for hours or days and then emerges, weak yet triumphant, solution in hand. In his representation, mental work is *hard* work. Brainwork is as laborious as, and at one with, handwork.

The Limits of Transactional Thinking and Mechanic Materiality

The manuals posit that good teachers can displace the mental and physical burdens on students of learning new, difficult material, and the examples within their pages also provide both the readers' minds and bodies with exercises to make them stronger, faster, more focused, and more patient. Even the most conditioned, however, sometimes need relief, and ciphers exist that even the genius decipherer cannot solve by brainwork and handwork alone. When teachers are not present to mediate, too, or when readers have either gone beyond the content of a textbook or found themselves in situations that book learning cannot anticipate, technological devices can compensate for the limitations of the human mind and body and extend their capabilities. As cognitive prosthetics, machines replicate quicker, more instant understanding. Their invention and use require the interdependent faculties of intelligence and physical labor, yet they also ease the burden of learning and mastery for the student. Diagrams of machines—some with working paper parts—are some of the more intriguing material features of the genre of the cryptography manual, and many of those diagrammed devices were actually built and distributed to the public. Trithemius's *Polygraphia,* for example, includes actual devices within the text in which a slide rule can pivot around a hub on a wheel. Radiating from the hub are lines of numbers, letters, or symbols. As the slide rule is rotated, it can align with different combinations of characters. Between the spokes are elaborate illustrations of cornucopias, disembodied angels with heads attached to platforms like trophies, and typographical ornaments in which faces protrude from leaves and sculptural details. And amazingly, even after almost exactly 500 years, the glue that holds the slide rule against the hub still secures it yet also allows it to swivel effortlessly around the disk.

Though his pamphlet is rare and not widely accessible, Samuel Morland's decryption device, the Machina Cyclologica Cryptographica, is a clear example of the artificial intelligence cryptographers created to supplement and extend human cognition. Unlike Trithemius's, which could be used immediately by a reader working with a cipher in the text, Morland's tool must be cut out and assembled. Each separate disk is provided so that a reader can indeed put it together manually and test it on the exercises in the pamphlet. Morland's invention is also similar to earlier cipher disks, like Alberti's.[55] Yet, the color illustrations he provides, and the six working models that are still in existence, are much more elaborate than typical cipher disks. Their design and actual reproduction and impressive sales indicate not only that readers wanted to speed up their deciphering and calculating abilities but that it was fashionable to do so. Like Trithemius's disk, Morland's is aesthetically

interesting. Printed in color, the device features a dark pink rose in bloom as its hub and has five multicolored rings of letters and numbers. Morland boasts that "in fine, the nature of this *Machina* is such, that in long Writing each letter of the Alphabet may stand both for itself and all the rest, which makes the Intrigue a thousand times more difficult, and leaves the Discoverer in infinite Doubts, and Uncertainties."[56] Morland consciously markets the device to the paranoid as well as the reader who wants the latest technologies for problem solving; indeed, the Machina Cyclologica Cryptographica sells, as do Morland's other calculation devices. J.R. Ratcliff notes that Morland's machines were in solid demand by both court patrons and the public. They were priced at about £3 10s, which is the equivalent today to the cost of a high-end cell phone. And like wearable communication devices today, Morland's machines were pocket-sized, adorned with pleasing designs, and built with precious metals by the same craftsmen who made fine watches, such as Humphry Adamson, Henri Sutton, and Samuel Knibb.

Devices like Morland's Cryptographica Cyclologica, Kircher's acoustic cabinet, and Schotti's adaptation of Kircher in the Cistula Steganographica, posit an artificial intelligence to supplement the shortcomings of natural human ability, the limits of which are laid bare by the combinatory rigors of ciphering and deciphering. In *Mathematical Magick*, Wilkins openly acknowledges that artificial intelligence can improve, exercise, and overcome one's limitations by birth and wealth.[57] For Wilkins, the mechanical arts offer visible exercise for the mind as well as evidence of its processes at work as the hands manipulate the material features of the machine. Denise Albanese finds a similar philosophy at work in early mathematics instruction, where problems solved in writing in front of audiences made visible the otherwise invisible computational mind.[58] The numbers themselves, then, and their equations and solutions, are promoted in humanist public discourse as the materialization of thinking, separating mathematics from immaterial work with numbers in, for example, occult magic. "The experiments and observations of the self-professed Baconian organization, typified by the air-pump and the microscope," Lynch notes, "extended the range of human sensory experience and subjected our view of nature to the discipline of observation, rather than the authority of Aristotle."[59] Yet, like the instructional manuals, the decryption machines described in those textbooks are not dismissals of the ancient knowledge of Aristotle or other classical thinkers; rather, they build from the mechanical innovations of the past—specifically the communication technologies—as they embrace observable reality in the present.

As Quinn DuPont points out in his essay in this collection, devices like the cipher wheel, which had been in use for centuries, are combinatory machines. Early computers are, essentially, about making connections—across words and texts but also across temporalities—more quickly.

Other devices were less obviously predecessors of twentieth-century digital technologies but, still, were designed to allow for the recombination of moveable characters to reveal patterns across space and time. Like Kircher, for example, Morland would imagine recording devices that could seal in the reverberations of sound and release them later, extending both the physical, geographical reach of the human voice and the temporal extension of the voice through time. Morland details his "speaking trumpet" in *Tuba Stentora Phonica*, which could also be used for the transmission of secrets.[60] Selenus, too, describes "secret suggestion" by mechanical means, or the lowering of the human voice using apparatuses like speaking tubes. The idea of listening to an ancestor's voice, too, would continue to excite the early modern imagination through the eighteenth century and until the first phonograph in the nineteenth century.

The popular appeal of cryptography, and of deciphering in particular, as the material model of the superior intellect, obscures the centrality of the authority of sense-experience in the early pedagogies, as the manuals I have discussed have illustrated. Arguably, early modern cryptographers endorsed an early version of what we today call the human interface, where the body is seen as a surface and a series of controls to mediate and manipulate the outside world. Morland's Machina Cyclologica Cryptographica was a wearable touch screen technology that required multi-finger input. That these devices were mobile prosthetics to enhance both the physical and the intellectual capabilities of the human was not what made them unique—the book as object was also this kind of technology, as were devices created long before it. What was notable was the self-reflective way in which the technologies were consciously marketed to the public as a means to help users think more quickly, and with less physical effort and exhaustion, than previously possible. Seventeenth-century ciphering and deciphering technologies differ from precursors, like Alberti's cipher wheel, in the way they were designed and marketed to appeal to nonspecialist as well as specialist buyers. This marketing is part of the larger campaign of the mid-seventeenth century to legitimize the mechanical arts and sciences as subjects worthy of academic study. "The Royal Society's interest in the history of trades, practical mechanics, and systematic experimentation derive from a focus on manual objects and a belief in constructivist objectivity," Lynch finds.[61]

Intelligence and the Future of Cryptography

The materialization of intelligence as recombination, exemplified by deciphering and made popular by cryptography instruction manuals, noticeably shaped the biographical afterlives of figures like Trithemius, Selenus, Bacon, Wilkins, and Wallis well beyond the seventeenth century. Bacon's reputation has been perhaps most obviously impacted. While his

philosophical and political writings establish his magnitude as an historical figure, it is his "mystery," inspired by his interest in ciphers, upon which his status as "genius" has been argued, or at least presented as fact. Alfred Dodd, in *Francis Bacon's Personal Life-Story* (1949), explains that "the living complexities of genius" require his update of James Spedding's 1861 *The Letters and Life of Francis Bacon*.[62] "To-day," Dodd writes, "we are openly ashamed of our greatest genius" because all that is remembered about him is that he was convicted of corruption.[63] Dodd hopes to correct the error, presenting not the "open life" of Bacon but the "*concealed* one," capitalizing upon the rhetoric of secrecy that has sustained interest in Bacon amongst those who believe Bacon wrote William Shakespeare's plays, ciphered his own writings, and generally participated in a grand symbolic game that only readers skilled in deciphering can appreciate. Bacon is himself the bodily representation of a cipher, a "problem to be solved."[64] It is beyond the scope of this essay to summarize the longstanding debate about Bacon's ciphers, his involvement with the Rosicrucians and the Freemasons, and the authorship of Shakespeare; resources on the debate are plentiful. What each of these speculations emphasizes, however, is the idea of Bacon as a connector; he is hoped to be the key in a pattern that, if discovered, would reveal sudden truths about an entire era in human history. The website of the scholarly Francis Bacon Society (www.francisbaconsociety.co.uk) rightly points out that no matter what the cult appeal of Bacon may be, "the true intellectual significance of emblems and cipher [have been] marginalized."[65]

In practice, this historical emphasis on pattern recognition as the fundamental skill of the cryptanalyst and as a sign of genius, and on confidence in the imagination as the way in which the mind finds patterns, may have caused misdirection as often as it led to solutions. John Matthews Manly provides a poignant example of the errors that can result from the attitude that ciphered texts can be solved if only their patterns can be revealed. As noted in the introduction to this collection, and summarized in more detail in the afterword, Manly debunked a theory forwarded by William Romaine Newbold, a close friend and respected scholarly colleague of Manly's, that Roger Bacon had authored the Voynich manuscript. Newbold claimed to have discovered the cipher systems at work in the Voynich. But as Manly explains in his meticulous review of Newbold's theory in the 1931 *Speculum* essay, "In my opinion, the Newbold claims are entirely baseless and should be definitely and absolutely rejected."[66] In his article, Manly demonstrates that the danger of ontological openness, and of expanding one's perspective to take in all multimodal possibilities, is that the imagination can begin to form connections where they are in fact not present. Manly calls this "extraordinary ingenuity," or an interdisciplinary, multimodal genius that gets away from itself.[67] Newbold believed that Bacon had invented a microscope, for example—centuries before its documented

invention—and used it to trace tiny ciphers within the ink. Manly finds the idea exciting but very unlikely. "To me, the scattered patches of 'shorthand signs' with which Professor Newbold operated seem merely the result of the action of time on the ink of the written characters." "The vellum of the MS has a very rough surface, and the ink used was not a stain but a rather thick pigment. As the pigment dried out," Manly explains, "the variations in sedimentary deposit and the cracking produced the phenomena which Professor Newbold has taken to be microscopic elements in the strokes."[68] Manly uses his own material evidence to counter Newbold's suspicious observation, and he consults several palaeography experts for confirmation: Charles Henry Beeson, Berthold Louis Ullman, Fritz Saxl, Robert Steele, Sir Frederic Kenyon, and Eric Millar.

Newbold took other great liberties with the material text of the Voynich and additional texts he believed were ciphered. In one example, a scribe had inserted a work into the original text with a carat symbol, the revision then written above the line. Newbold actually transcribed that revised text as part of the original cipher with the word "carat" for the symbol that appeared within the line, and he then used the letters of "carat" as present in the text to decipher. In another decryption, Newbold took a symbol for what he believed was an asterisk and spelled out the word, "asteriscus" to reach his solution. Even without the questionable practice of spelling out symbol names and then using those spellings in the deciphering, Manly finds that the symbol was not even an asterisk but the alchemical symbol for alumen. Manly could have simply made these points, which seem "incredible" enough to discount his work without great detail, to use his word, but he instead works through both Newbold's and his own methods in great detail, exposing his mental and scholarly process.[69]

Manly was not excited about dismantling his colleague and friend's scholarship. "Before I had thoroughly tested the methods of Professor Newbold," Manly notes, "I was disposed to welcome his results, for I had long been romantically interested in Roger Bacon and was eager to believe, with Professor Newbold, that he was the greatest scientific genius the world has ever possessed."[70] He does so as a professional obligation to both medieval and early modern scholarship and to the discipline of cryptography. His analysis reveals the intellectual rigor that must be sustained during deciphering that is not limited to pattern recognition; the number of primary documents that must be consulted, translated, read, and interpreted, the languages that must be in one's repertoire, the knowledge of grammar, syntax, and historical context that is required, and the ability to step outside one's work and view it objectively that is needed. This is a point that Manly only mentions but that is one of the more significant messages of his review: pattern recognition alone, without the proper knowledge of context, can easily be

misleading. "To anyone who has ever played word-building games or worked anagrams," he explains, "it will at once be evident that out of so many as fifty-five letters—especially with the large liberty of equivalents permitted by this system—a considerable number of entirely different sentences can be constructed." "The production of intelligible words or sentences from a series of 50 or more letters is no guarantee that they represent any message intended by another person," Manly concludes.[71]

Robert Markley finds, in his assessment of Wilkins's more famous 1668 *An Essay Towards a Real Character and a Philosophical Language*, that Wilkins's universal language vision was a "failed effort to idealize a material order of 'things.'"[72] Wilkins's cryptography instruction in *Mercury*, and the work of his colleagues in other manuals of the period, may not be a successful effort to do the same—to create this order of things—but their lessons do provide early modern readers with a means of categorizing intelligence as material. Early modern cryptography pedagogy, in general, provides a case study in how the processes of discovering connections, recognizing patterns, and rearranging language became valued as foundational concepts of intelligence. Devices that materialized and made visible the cognitive problem solving process became wearable fashion, and publications like the *Weekly Memorials for the Ingenious* (first published in 1681) tantalized readers with challenges. The message of pedagogical accessibility in these cryptography manuals, that anyone could learn the discipline with practice and hard work and improve their intelligence, helped give cryptography amateur appeal. Since the seventeenth century, and also since Davys's editing of Wallis as an icon of genius, the popular imagination has glamourized the cryptanalyst as a tireless laborer, the fatigued but ultimately triumphant hero of sudden revelation working in the background, hungry for more puzzles but not for fame. Manly's rigorous scholarly analysis of Newbold's methods, and through Newbold of Bacon's writings, the Voynich manuscript, and other medieval and early modern archives, began to reveal the consequences of that popular image and the need for more investigation of the social, economic, political, linguistic, historical, and aesthetic importance of the culture within which ciphering and deciphering have been taught. Such studies can reveal, as this one does, that the discipline of cryptography should occupy a more important position in our understanding of literacy and the multimodalities of human communication.

Notes

1 John Baptista Porta, *Magiae naturalis, sive, De miraculis rerum naturalivm libri IIII* (Naples: Matthias Cancer, 1558).
2 John Wilkins, *Mercury; or, The Secret and Swift Messenger* (London: I. Norton for John Maynard and Timothy Wilkins, 1641), 29–30. References are to this edition.
3 Ibid., 30.

4 Edward F. Hulme, *Cryptography; or the History, Principles, and Practice of Cipher-Writing* (London: Ward, Lock and Co. Limited, 1898), 26; Laurence D. Smith, *Cryptography: The Science of Secret Writing* (New York: Courier Dover Publications, 1955).
5 Francis Bacon, *Of the Advancement and Proficience of Learning; or, The Partitions of Sciences*, trans. Gilbert Wats (Oxford: Leonard Lichfield, 1640), 3.318.
6 Gustavus Selenus was an alias for Augustus of Brunswick-Lüneburg or August, Duke of Braunschweig-Lüneburg. Gustavus Selenus, *Cryptomenytices et Cryptographiae Libri IX* (Luneburg, Sternen, 1624), 8. *Cryptomenytices* is sometimes referred to by its half title, *Systema integrum Cryptographiae*.
7 Todd Butler, *Imagination and Politics in Seventeenth-Century England* (Surrey: Ashgate, 2008), 10.
8 Steven Shapin, *The Scientific Revolution* (Chicago, IL: The University of Chicago Press, 1996).
9 Gustavus Selenus, *The Cryptomenytics and Cryptography of Gustavus Selenus in Nine Books Wherein is also contained a most clear Elucidation of the Steganographia, a book at one time composed, in Magic and Enigmatic form by Johannes Trithemius, Abbot of Spanheim and Würzburg, a Man of Wonderful Parts*. Translated by John William Henry Walden (1900), 11. References are to this edition. Walden's translation was intended to be published, but for reasons not recorded, it was not. It is located in the Fabyan Collection at the U.S. Library of Congress, call number Z103.A95 1900.
10 John Davys, *An essay on the art of decyphering, in which is inserted a discourse of Dr. Wallis. Now first publish'd from his original manuscript in the publick library at Oxford* (London: L. Gilliver and J. Clarke, 1737). References are to this edition.
11 Hulme, *Cryptography*, 14.
12 For more detailed information about both the textual tradition and the structural conventions of seventeenth-century cryptography manuals, see Katherine Ellison, *A Cultural History of Early Modern English Cryptography Manuals* (New York: Routledge, 2016), 21–44, 45–67.
13 Bacon's theoretical *Advancement of Learning* explains the usefulness of bilateral cipher, but it is not a dedicated technical communications publication in the same way as Wilkins's *Mercury* or Morland's *New Method* is.
14 Wilkins, *Mercury*, 4.
15 Ibid., 5.
16 John Wilkins, *An Essay Towards a Real Character and a Philosophical Language* (London: Printed for Sa: Gellibrand and John Martin, 1668).
17 See Ellison, *Cultural History*, 90–110, 111–33.
18 Sean Silver, *The Mind is a Collection: Case Studies in Eighteenth-Century Thought* (Philadelphia: University of Pennsylvania Press, 2015).
19 Francis Bacon, *De Dignitate & Augmentis Scientiarum*, in *Opera Francisci Baronis de Verulamio* (London: John Haviland, 1623).
20 Ibid., 22.
21 Selenus, *Cryptomenytics and Cryptography*, 396.
22 Ibid., 8.
23 Athanasius Kircher, *Polygraphia Nova et Vniversalis ex Combinatoria Arte Detecta* (Rome, Varese, 1663).
24 P. Gasparis Schotti, *Schola Steganographica* (Societatis Jesu, 1680).
25 Leon Battista Alberti, *The Mathematical Works of Leon Battista Alberti*. Ed. Kim Williams, Lionel March, Stephen R. Wassell (Basel and London: Birkhäuser and Springer, 2010).

26 Bernard Ycart, "Letter Counting: A Stem Cell for Cryptology, Quantitative Linguistics, and Statistics," *Historiographia Linguistica* 40, no. 3 (2013): 304.
27 William T. Lynch, *Solomon's Child: Method in the Early Royal Society of London* (Stanford, CA: Stanford University Press, 2001): 24.
28 Lynch, *Solomon's*, 24.
29 Anthony Grafton, "Kepler as a Reader," *Journal of the History of Ideas* 53, no. 4 (1992): 564.
30 Selenus, *Cryptomenytics and Cryptography*, 440.
31 Galileo Galilei, *The Assayer* (Rome, 1623); Grafton, "Kepler," 562.
32 Johannes Walchius, *Decas fabularum humani generis sortem, mores, ingenium … cum ad vivum, tum mythologice adumbrantium: theologis sacra: jureconsultis justa: medicis salubria: philosophis vera: stolidis incongrua dictantium: novo qvodam dicendi genere atque insolita serminis forma constructa … per Joannem Walchium Schorndorffensem* (Strasbourg: Zetzner, 1609).
33 Selenus, *Cryptomenytics and Cryptography*, 412.
34 Ibid., 413.
35 John Wilkins, *The Discovery of a New World; or, A Discourse Tending to Prove, That [It Is Probable] Our Earth Is One of the Planets* (London, 1638), 3–5.
36 Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago, IL and London: The University of Chicago Press, 1994), 200.
37 Lynch, *Solomon's*, 2.
38 Samuel Morland, *A New Method of Cryptography* (London: 1666), 4.
39 Ibid., 8.
40 Shapin, *Social History,* 199.
41 See William I.B. Beveridge, *The Art of Scientific Investigation* (New York: Random House Books, 1957); Denise Shekerjian, *Uncommon Genius: How Great Ideas are Born* (New York: Penguin, 1991); and Darrin M. McMahon, *Divine Fury: A History of Genius* (New York: Basic Books, 2013).
42 Paul Rand, *From Lascaux to Brooklyn* (New Haven, CT: Yale University Press, 1996), 50.
43 Ibid., 50.
44 Selenus, *Cryptomenytics and Cryptography,* 7.
45 Selenus's efforts are successful, though it will not be widely known until 1996 and 1998 with Thomas Ernst and Jim Reeds's verifications. See Thomas Ernst, *Schwarzweisse Magie. Der Schlussel zum dritten Buch der Steganographia des Trithemius* (Amsterdam: Rodopi Bv Editions, 1996); Jim Reeds, "Solved: The Ciphers in Book III of Trithemius's *Steganographia*," *Cryptologiaci* 22, no. 4 (1998): 291–317.
46 Selenus, *Cryptomenytics and Cryptography,* 8.
47 Ibid., 9.
48 Davys, *Essay*, 11.
49 Ibid., 12.
50 Ibid., 13.
51 Selenus, *Cryptomenytics and Cryptography*, 7.
52 Davys, *Essay*, 15, 17.
53 Butler, *Imagination,* 9.
54 Gail Kern Paster, *Humoring the Body: Emotions and the Shakespearean Stage* (Chicago, IL: University of Chicago Press, 2010), 8.
55 The Machina Cyclologica Cryptographica is not well known because, generally, Morland's contributions to computing history have been understudied.

This is in part because his similar arithmetic calculators do not have a carry mechanism (a way of carrying over from one column to the next for accurate calculation), as explained in Jessica R. Ratcliff, "Samuel Morland and His Calculating Machines *c.* 1666: The Early Career of a Courtier-Inventor in Restoration London," *BJHS* 40, no. 2 (2007): 159–79.

56 Morland, *New Method*, 12.

57 John Wilkins, *Mathematical Magick* (London: Printed by M.F. for Sa: Gellibrand, 1648), 2.

58 Denise Albanese, "Mathematics as Social Formation: Mapping the Early Modern Universal," in *The Culture of Capital: Property, Cities, and Knowledge in Early Modern England*, ed. Henry S. Turner (New York: Routledge, 2002), 255–74.

59 Lynch, *Solomon's*, 2.

60 Samuel Morland, *Tuba Stentoro-Phonica, An Instrument of Excellent Use, as Well at Sea, as at Land, Invented and Variously Experimented in the Year 1670, and Humbly Presented to the Kings Most Excellent Majesty Charles II, In the Year, 1671* (London: Printed by W. Godbid, 1672).

61 Lynch, *Solomon's,* 23.

62 Alfred Dodd, *Francis Bacon's Personal Life-Story* (London: Rider and Company, 1949), 11; James Spedding, *The Letters and Life of Francis Bacon*, Vol. I (London: Longman, Green, Longman, and Roberts, 1861).

63 Dodd, *Francis Bacon's*, 13.

64 Ibid., 13, 15.

65 "Emblem and Cipher." Francis Bacon Society Website (2014): www.francis-baconsociety.co.uk/emblem-and-cipher/.

66 John Matthews Manly, "Roger Bacon and the Voynich MS," *Speculum* 6, no. 3 (1931): 347–48.

67 Ibid., 391.

68 Ibid., 353.

69 Ibid., 368.

70 Ibid., 347.

71 Ibid., 350–51.

72 Robert Markley, *Fallen Languages: Crises of Representation in Newtonian England, 1660–1740* (Ithaca, NY: Cornell University Press, 1993), 9.

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10 "What I Write I Do Not See"

Reading and Writing with Invisible Ink

Karen Britland

I want to begin this chapter with a letter signed by someone named Jane Short (Figure 10.1). It was written by a sister to her brother, who was apparently abroad, and it mentions a series of family relationships. It speaks of marriages, mentions their mother affectionately, imparts quasi-confidential business information about debt and credit, and is written in the round, open handwriting associated with women in the period. The letter has a direction on the back which reads: "For her louing brother Mr Thomas Short, these, At Rochel."[1] On the surface, it seems like a perfectly innocent letter by a sister to her brother about family affairs. However, it also engages in deliberate misdirection (doubly so as it is printed here because I have digitally altered its appearance).

If one were to call this document up in the National Archives at Kew, it would become rapidly clear that another letter is written on the same page in invisible ink (Figure 10.2). This other letter is signed by Will Tyler (almost certainly a pseudonym), and it deals with troop movements and political events that can be dated to 1650. It is written in an ink that has been developed by wiping a reactive agent over the whole page, perhaps by its intended recipient, but more likely by a parliamentarian agent, since it was apparently intercepted and is now to be found among the interregnum state papers. The letter raises problems for interpretation, and it would take a massive effort to reconstruct even the most basic historical information about it—for example, who wrote it and to whom? Did Jane and Thomas Short exist? Was the visible letter in "women's" handwriting written by a man or a woman?

When critics talk about invisible ink, they tend to be concerned with similar things: how it was fabricated (using lemon juice, urine, or, in the Short letter's case, copper sulphate reacting with gallo-tannic acid) and when was it invented (Ovid mentions invisible ink in relation to love letters; the Greeks and Persians apparently used it during war).[2] Information about invisible, or "white" ink, was available in England during the sixteenth and seventeenth centuries in books such as Giambattista della Porta's *Natural Magic* (1589). Mary Queen of Scots instructed her supporters in the use and composition of a secret ink made from alum (potassium aluminum sulfate) while she was detained under house arrest

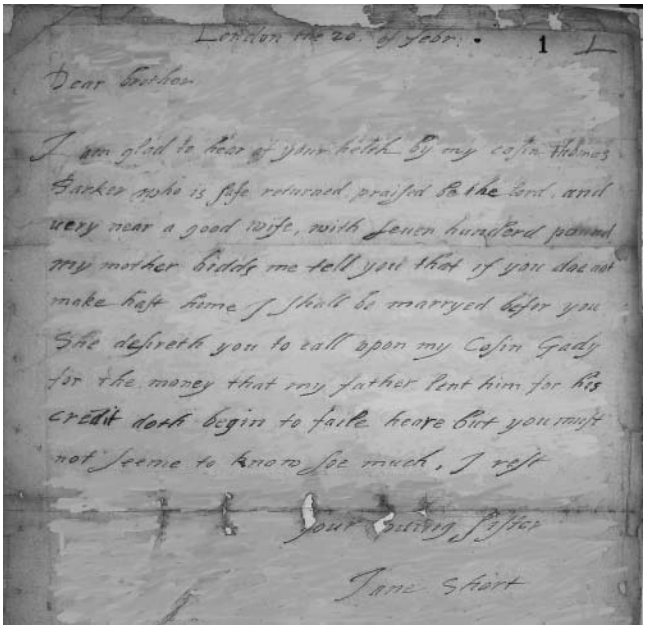
London the 20. of Febr. 1
Dear Brother
I am glad to hear of your helth. My cosin Thomas
Barker (who is safe returned praised be the lord) and
very near a good wife, with fiveen hundred pownd
my mother bidds me tell you that if you doe not
make hast home I shall be marryed befor you
She desireth you to call upon my Cosin Gady
for the money that my father lent him for his
credit doth begin to faile heare but you must
not seeme to know soe much. I rest
your loving Sister
Jane Short

Figure 10.1 Letter signed by Jane Short. The National Archives, Kew, UK, State Papers 18/9, fol. 1.

by Elizabeth I.[3] In contrast to these already established ways of thinking and writing about invisible ink, I want to explore two things. First, I briefly discuss the stereotypes that were put into play around secret writing in the early modern period, using this as a way to investigate women's participation in the Wars of the Three Kingdoms and to highlight the manner in which gendered narratives both constrained and facilitated this participation. Second, I consider more broadly how invisible letters materialize and dematerialize the place of writing in early modern correspondence: that is, I am interested in the ways in which secret writing brings into focus the interconnections between writing and reading, at the same time as it draws attention to the surfaces upon which writing happens. Invisible ink letters inhabit a place in-between material support (the page and what is on the page) and the expectation of some kind of meaning. This is perhaps no different from any process of reading, but invisible ink letters, as I will discuss, manifest this process in particularly telling ways. I consider, then, how invisible writing draws attention to writing surfaces, how it throws into relief the vulnerable relationships between letter writers and recipients and, ultimately, how it becomes a metaphor that allows us to think through a reading and writing process that transcends physical support.[4]

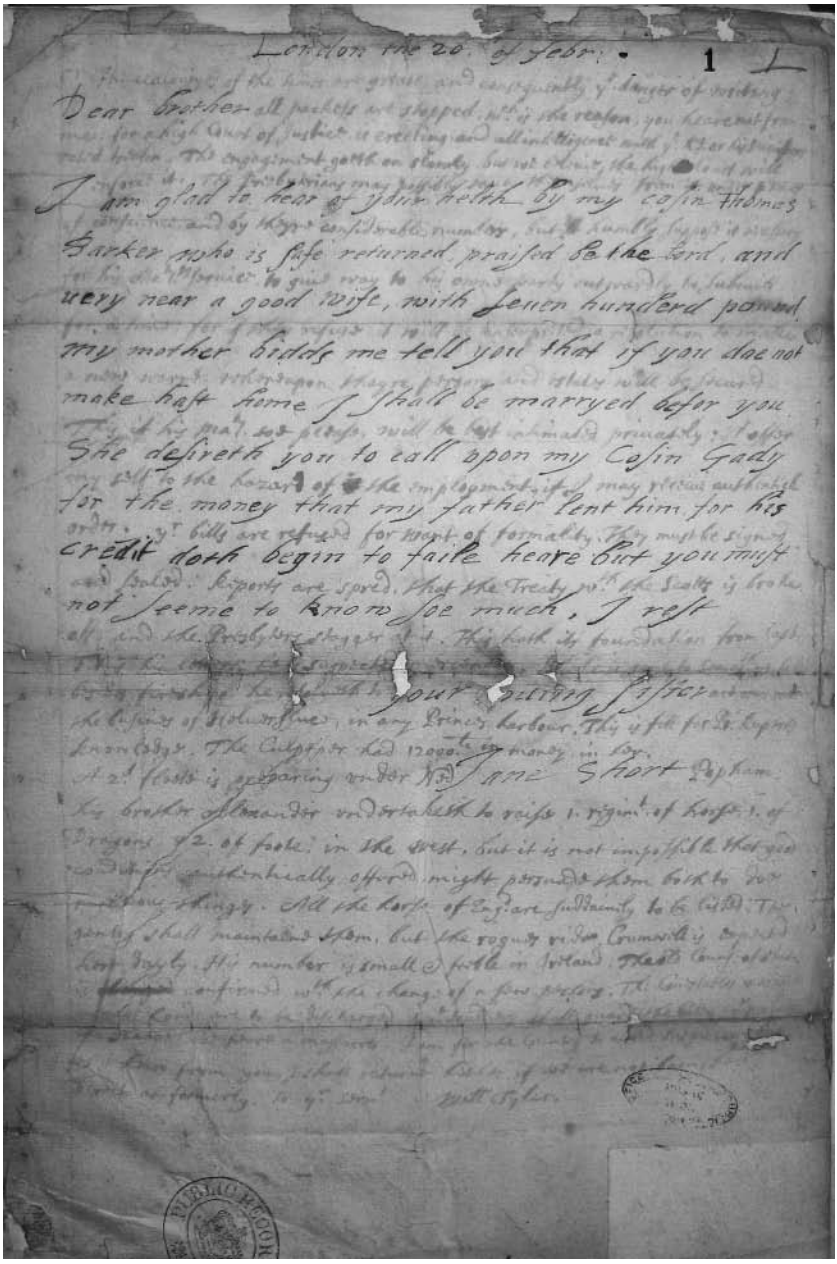

Figure 10.2 Letter signed by Will Tyler in invisible ink, visible within the letter signed by Jane Short. The National Archives, Kew, UK, State Papers 18/9, fol. 1.

Women and Invisible Writing

As with the Jane Short letter with which I began, a number of clandestine letters use women's names as an additional cover for their invisible-ink messages. In 1658, for example, John Thurloe, secretary to the Council of State, intercepted a letter written ostensibly by a certain Mary Welsh to her nephew. This discussed family news and expressed the hope that the latter's aunt would soon recover from an illness.[5] Like the Jane Short letter, this document mobilizes several stereotypes about women, presenting itself as innocently domestic and devoid of political speculation. To reinforce this stance of political detachment, it also puts forward a sense of devout providentialism (particularly in its assertion, "I hop you will be able to prevale with your a[u]nt, to have patience, and not to vex and be trobled at that she cannot help"), creating the impression that the letter-writer desires her nephew to encourage acceptance and non-engagement in their sick relative. However, again like the Jane Short letter, it contains another letter hidden within it, which mentions that several regiments are in the process of being mustered, and it passes on the news that "Sir Edward Herbert is dead, and Sir Edward Hide is made lord chancellor."[6] Since the document was intercepted and its secrets revealed, it is important to note that this seemingly innocent and feminized cover did not work: by 1658, some parliamentarian operatives were clearly not blinded by stereotypes of women's lack of political awareness or inability to engage in subterfuge and complicated methods of communication.

Only four years earlier, though, a letter written by Anne, Lady Rochester made it into her husband's hands, although a packet of correspondence from Edward Hyde, within which it was enclosed, was lost and never received.[7] After investigations were undertaken into this event, the Royalists surmised that Hyde's letters had fallen into "the hand of some of Cromwell's ministers," but that Lady Rochester's letter had either tumbled out "when the main packet was opened, or it was judged to be in a woman's hand, and so to contain nothing of business."[8] This explanation demonstrates *not* that the parliamentarian interceptors necessarily had a gendered view of women's political (in)abilities, but that they were *perceived* to hold this view by a Royalist élite. Although, from the first, parties on both sides of the conflict used women and girls to write, transport, receive, and pass on sensitive materials, the idea persisted in some quarters that women, through their very status as women, were subject to different rules than their male correspondents were, in a manner that rendered their letters somehow less noticeable or subject to interception.

That said, women certainly did participate in correspondence using invisible ink, and I want to pause here to consider in some depth one historical instance of this type of communication before moving on to

discuss the ways that invisible ink might change or problematize how we think, more generally, about reading and writing. While we have no way of knowing whether the letters by Jane Short and Mary Welsh were actually written by women or, instead, by men adopting a form of handwriting that appeared feminine, the Royalist Lord Inchiquin, as I will discuss, was involved in an invisible-ink correspondence that relied on and was initiated by women.[9] This is important, not least because it marks a moment in which the production of secret ink straddled two spheres: a nascent scientific sphere, characterized perhaps by the work of a man such as Robert Boyle, whose papers, now held in the Royal Society archives, contain recipes for secret inks (as well as experiments to make such inks from substances like blood plasma); and the sphere of home medicine, dominated by women, characterized perhaps by the 1655 publication of *The Queens Closet Opened*, a book of recipes ostensibly collected by the English Queen Henrietta Maria, which, alongside instructions for the manufacture of cold syrups and purging ales, also contains several recipes for making "*Letters of secrets that they cannot be re*[*a*]*d*."[10] As Doreen Cripps has noted, the "seventeenth-century still-room abounded in possibilities for secret research."[11] We should not, then, be tempted to take women's strategic self-effacements at face value: their correspondence and commonplace recipe books evince facility for and fascination with secret writing equal to those in the works of men.

During the summer of 1659, as the Royalist uprising known as Booth's rebellion began to gather momentum, the Scottish Lord Inchiquin, who was in exile in Paris, corresponded regularly with women from the Murray family, who were resident in England. Because of their letters' dilatory arrival, certain members of the group rapidly began to suspect that their correspondence was being intercepted. In May, for example, Elizabeth Murray, countess of Dysart, informed Inchiquin that her letters to him were all "vndoubte[d]ly opened," disingenuously noting, however, that they contained "so little matters" that they ought to be "nedglected."[12] Nevertheless, writing a few days later to Lady Anne Murray, the countess's sister, Inchiquin more optimistically remarked that, although the letter he was expecting from her had probably miscarried, it was not "lieke it should be intercepted," because all his other correspondence had arrived safely.[13] He was spectacularly wrong. His correspondence was most certainly being intercepted and copied by officials at the English post office.[14] Somewhat hilariously, it was also being intercepted and copied in France by Antoine de Marcés, a French post office official who was working for Sir Edward Hyde and the exiled Royalist court of Charles II, all of whom had reason to suspect Inchiquin's Royalist allegiances.[15] It is little wonder that Inchiquin was occasionally befuddled by the inconsistent arrival of his correspondence, and it is to the countess of Dysart's credit that she correctly surmised that interception was to blame.

Inchiquin's allegiances had been sorely tested during the civil conflict, leading him to abandon King Charles I's cause between 1644 and 1648.[16] In 1650, though, after breaking with the Parliamentarians, he followed the Royalist marquis of Ormond into exile, gaining Hyde's approbation and a place on the king's council. Seven years later, he converted to Catholicism, disrupting the trust of his Royalist associates and provoking Hyde to keep an eye on his mail. While Inchiquin was no longer included in Charles II's inner circle, his connections with the countess of Dysart and her sisters show him to be involved in the plans of the group of Royalist activists known as the Sealed Knot.

Dysart, in her turn, was the eldest daughter and heir of William Murray, a gentleman of the bedchamber and Charles I's childhood companion. She succeeded to her father's title in 1655 and, although she was known as a friend to Oliver Cromwell, she was also a clandestine operator for the Royalist cause, carrying on secret correspondences with the king's supporters and travelling abroad on what her modern biographer has called "mysterious missions."[17] Her association with Cromwell led some Royalists to think both she and Sir Lionel Tollemache, her first husband, were Parliamentarian spies, but her connections with the Protector seem to have been strategic (after his death, she commented of "the old on[e]" that she sincerely hoped she would "neuer know his fellow").[18] Her house at Helmingham in Suffolk has been called "a rallying point for Royalists," and, in 1662, she was awarded an annual pension of £800 from Charles II, which several modern commentators intimate was a Restoration reward for her loyalty.[19]

In the summer of 1659, Dysart was the driving force behind Inchiquin's adoption of invisible ink. For example, that July, Inchiquin somewhat sheepishly admitted that he had inadvertently burned the instructions she had sent him that explained how to use "the poweder." Using barely veiled language, which attempted to position this substance as a medicinal remedy for a child, Inchiquin explained that he had tried to reconstruct the procedure from memory but had more or less failed. He had made an experiment, he said, the results of which were "disernable" but "did not clearly produce that effect [he] expected."[20] A week later, he was waiting for another delivery of powder, which had not arrived, and was planning to recommend its use to "m^{r} hardin," whom he thought might "likely haue equall benefit by it."[21] In the middle of August, Lady Dysart responded to Inchiquin's request for duplicate instructions, advising him to "make vse of the powder with discretion," and not to let it stand "to[o] long in the watter, that it coms not to[o] deepe in colour because it should be to[o]stronge and for the witt [i.e. white] powder alsoe to haue care that nobody taste of it."[22] In her next letter, intercepted and summarized by a Parliamentarian agent, Dysart instructed Inchiquin to "make vse of ye powder this weeke."[23] At the same time, Inchiquin was encouraging Dysart, in her turn, to employ the powder, again couching

his exhortations in medicinal terms. "I pray neglect not now to vse the powder, it being the season for it," he advised, further recommending that she "apply it as wel betweene the Ribbs as belowe."[24] It does not take much of a leap of faith to see this as an instruction to use secret ink to write both between the lines of a letter and at the bottom of the page, and it is clear from the interaction that the recipe for the use of the powder originated with Dysart, not Inchiquin.

Dysart's letters to Inchiquin, in which she discusses the powder, not only mobilize a narrative of health and home remedy as a cover for political correspondence, but, like the Short and Welsh letters, situate Dysart as a node in a network of family and friendship relationships. Like the Mary Welsh letter, they are also notable for their reiteration of Dysart's political disinterestedness. Deliberately positioning herself as a woman concerned only for news of her child, Dysart's letters repeat sentiments such as: "I am sure if Innocence be a pleasure I haue it," or "I can say Confidently I neuer did wish nor act to ye hurt of any," or "it is a great content not to haue malice, nor couett others, but to find quiett within."[25] What these letters achieve, as well as the mobilization of gender stereotypes that position Dysart as a health- and care-giver, is the construction of a discourse that is at least double, if not multiple—one that speaks both to the letter's addressee and its potential interceptor, maintaining an awareness of both. To an imagined eavesdropper, she presents herself as a non-actant in the conflict; to her intended recipient, she is at once a valuable political ally and also a modest and self-effacing woman, mobilizing her domestic talents in the service of the Royalist cause.

It is to this awareness of multiple audiences and over-lapping speaking positions that I now turn as I discuss the ways in which letters written in invisible ink bring a heightened awareness to our perception of the processes of reading and writing, and how they construct and disrupt notions of reading as a private affair.

Reading and Writing: Letter Writers and Recipients

The quotation in the title of this chapter, "What I write I do not see," comes from the first line of a poem by Abraham Cowley, Royalist poet and secretary, entitled "Written in Juice of Lemmon" and published in 1656.[26] The poem's first lines imply that the poet's correspondence is so private that even he, its author, cannot read it. He notes: "Whilst what I write I do not see, / I dare thus, ev'n to *you*, write *Poetrie*" (*ll* 1–2). The idea of the use of invisible ink here is mildly liberating since it allows the poet to write in a way that can cause a certain self-effacement. His mistress becomes the first person to "see" the activated writing as it is heated into visibility, and the lover, addressing his paper, notes: "Thou now maist change thy *Author's* name, / And to her *Hand* lay noble claim;

/ For, as *She Reads*, she *Makes* the words in Thee" (*ll* 40–42). The use of invisible ink, then, makes reading a physical, as well as visual, process, and reveals the complicity of a reader in interpretation. Tim Morris, writing about this poem, observes that it "seeks to abolish interpretive uncertainty or misunderstanding by the performance of a total transfer of authorship," adding that the technique may provide for the reader a "plausible denial of the true author's name in the face of discovery."[27] Placing authorship and responsibility with its reader, the invisible ink poem seems to occlude the identity of the work's writer, drawing attention to the complicated emptying out of authorship in letters of this nature. Invisible ink, particularly when combined with other strategies such as the pseudonyms present in the Short/Tyler letters, works to underline the precariousness of a writing identity. This is perhaps why there is a strong history of invisible ink and love letters (which characterize a relationship in which the sender's vulnerability to the recipient is already at stake).[28]

In a very real sense, moreover, the person *writing* a letter with invisible ink has not seen that letter and does not know everything that it contains (and is ignorant of its blots, mistakes, and imperfections). Despite its real (but invisible) presence on the page, the letter exists in potential, as an ideal in its writer's mind, until it reaches a second person who activates its actual message (blots, imperfections, and all). A recipient who activates an invisible ink letter, then, and who brings to light its hidden message, not only operates in tandem with the letter's writer, sharing responsibility for bringing the letter's message to light, but also reveals the letter writer's mistakes and vulnerabilities in a manner that can be productively imagined by considering the early modern notion of "sympathy."

In England, by 1677, chemically reactive inks had come to be called "sympathetical." The word "sympathy" had been around for about a century at that point and was used to demonstrate an invisible (sometimes mystical and secret) connection between things or people (often, lovers). In 1572, for example, Thomas Paynell's translation of the French *Treasurie of Amadis* included a letter from a lover to his mistress, which stated: "Simpathie … engendreth a certain entire, fervent, and inviolable amity, of the which our first love between you and me doth give us witness."[29] The idea of the heightened privacy of a clandestine romance permeates the tradition of letters in invisible ink in a manner that helps us to comprehend gendered narratives, such as Dysart's, which rely on notions of personal and familial love to justify an entry into the realm of secret writing.

At the time of the Wars of the Three Kingdoms, however, the word sympathetical was being used most famously, not in connection with clandestine romance, but with "sympathetical wound powder," a solution (usually of "vitriol"—that is, any metal sulfate) into which blood-covered

bandages might be dropped, curing, from a distance, the wound they had wrapped. When Kenelm Digby explained the process in 1658, he invoked the theory of atoms and described how invisible vibrations connected objects that were far distant from each other.[30] For Digby, the word "sympathetical" was not quasi-mystical but proto-scientific: it signified an invisible affinity that could be maintained across distance and which drew attention to the connection between two distant bodies. In the case of wound cures, this connection could be beneficial and caused physical healing. In the case of invisible letters, which may be seen to knit up the distance between two correspondents, the same is metaphorically true. The use of invisible ink posits a strong and personal connection that is maintained in trust between two or more people. Nevertheless, like sympathetic wound powder, the mechanisms of which Digby struggled to explain scientifically, invisible correspondence was physically tricky to effect and was a far-from-fail-safe mode of communication that, as I will discuss, not only bound correspondents together in sympathy but also exemplified their vulnerability one to the other.

Secret ink was difficult to use and needed practice. To use Digby's terminology, the sympathetical bond was not fool-proof and generated anxiety. For example, the exiled Charles II, negotiating with Scottish lords in 1653 before what would be known as the "Glencairn Uprising," delegated this kind of secret writing to a co-conspirator, because, as he said, he was "not able to write this way so much."[31] James Livingston, Lord Newburgh, who was involved in the same plot and writing the same year to an unknown correspondent, leaves us evidence of the imperfect nature of such communication when he notes: "ye whyte inck you haue vsed in writing these last letters is so pale, yt it will not appeare wth ye other powder … I cannot read a word & therfore I must desire you to recollect yor thoughts, and write it ouer againe in ye same kind wth more powder, for formerly yor letters were very leageable."[32] There is a strong connection here between the legibility of thoughts and the legibility of words on the page, not least because, for anyone versed in writing in invisible ink, there is a very real sense that the act of writing invisibly is more than usually fleeting since one's words evaporate into invisibility as they dry on the paper and, like thoughts, one has to work to recollect them.

The initial illegibility of letters written in invisible ink also brings to the fore the question of authorial authority. Again, in the letter with which I began, "Will Tyler" offers himself to hazardous employment if he might "receive authentic orders."[33] These authorize him to act among other Royalists and also afford a certain amount of protection if he is captured.[34] After 1643, ciphered or clandestine communication with the king was outlawed by Parliament, so orders and commissions in invisible ink became particularly problematic, and invisible ink letters seem to have been seen as less authoritative than other types of

writing. Commissions and orders *were* transmitted in white ink, but their authority could be challenged. For example, during Charles II's Scottish negotiations we find another letter—apparently addressed to Lord Bedford from Paris—which talks about invisible ink *in* invisible ink. It observes: "in your next pray write particularly what 120. 36. 150 you would haue & in what manner sent to you for if it should be either in cypher or white inke, perhaps it will not satisfy such persons as you would shew it unto."[35] In this instance, an order in invisible ink is deemed less stable and authoritative than a standard, sealed, royal commission. The challenge to royal authority posed by the War of Three Kingdoms is emblematized in this situation as King Charles II's straitened circumstances reduced him to negotiating with his potential allies in documents that were more-or-less invisible. Invisible ink therefore helps to underline for us the destabilization of existing notions of legitimacy and authority, drawing attention to the fluctuating, compromised and threatened identities of Royalist activists, and also underlining the paranoia and distrust that the turmoil of civil unrest perpetuated in English society during the wars.

Indeed, what I find most fascinating about invisible ink in this period is the way in which it forces us into suspicion, causing us to look at letters and other transmitted documents in different, heightened ways. For example, a letter in invisible ink was sent to Charles II from England in 1660 on the back of a printed Parliamentary proclamation, intriguingly repurposing a order from the Council of State for the Royalist cause.[36] To return to the example of the Bedford document, it might be said that the invisible letter acts like a clandestine passenger or stowaway inside the visible document. Another letter might be described as being in potential inside it, waiting to be activated. This might lead us to do things to paper that we would not normally do when reading a page; it might lead us to look at a letter in a different way. Morris says something similar when discussing Cowley's lemon juice poem. He asks: "What reader … first considers the text only as an object; not an object of theory but an object of the world?"[37] This notion is intrinsic to writing in invisible ink across time and is brought humorously to life in Rabelais's *Pantagruel* (1534) when Pantagruel receives a letter from a lady in Paris that contains a ring and a blank piece of paper. Pantagruel and his friend Panurge are convinced the paper contains a secret message, and they submit it to a series of fantastical tests to make it give up its meanings. These include oiling it with bat grease to see if it is written with whale sperm and rubbing it with milk from a woman nursing her first-born daughter to see if it is written with the blood of red toads. The paper remains stubbornly mute, and the secret message is finally discovered to be inscribed on the inside of the ring.[38] This episode plays on the nature of decoding and suspicion, and its humor arises from the fact that a secret message does exist *somewhere*—it is just not where it was initially

suspected to be. Two figurations of the secret arise from this moment: the secret as a thing (the Parisienne's letter contains a secret that must be brought to light), but also the secret as an experience (the possibility of a secret places everything under suspicion and gives every object or piece of paper the potential to be itself and something else, and nowhere is this more evident than in the epistemological chaos of the War of Three Kingdoms).

Rabelais's episode, then, gives a sense of the occult flavor of secret writing that inheres in a combination of a letter's occluded knowledge and the mobilization of natural substances to elucidate meaning. Indeed, recipes are said to exist that explain how to make secret ink formulas which, using a reactive liquid, allow a recipient to erase one visible, inky message to reveal another message written in invisible ink beneath it.[39] In such cases, the original message itself becomes invisible, but we can imagine that it has been read and therefore now exists in its recipient's mind. It has disappeared, but, in a way, it also has not. Its meaning has somehow been freed from the surface of the paper and has been transferred elsewhere. The invisible ink letter, with all its compromising secrecy and the way it calls identity into question, becomes bound with the mind and body that receives it, and somehow also writes it. Invisible ink letters materialize this process: a writer cannot ever truly know what he or she has written, and a reader brings the message to light when he or she reads it for the first time. In the process of coming to light, the message is freed from the page (sometimes quite literally through processes of fading or erasure) and renders the sender and recipient vulnerable to each other. Each encounters the shared secret as an experience—it is no longer an external phenomenon but becomes a part of each of them and their relationship one to another.

Invisible Ink as Metaphor

The most prevalent metaphor involving invisible ink in the early modern period concerned the evocation of sin. Cowley deploys this imagery in his poem when he writes of his love letter:

> Alas, thou think'st thyself secure
> Because thy form is *Innocent* and *Pure*:
> Like *Hypocrites*, which seeme unspotted here;
> But when they sadly come to dy,
> And the last *Fire* their Truth must try,
> *Scrauld* o're like thee, and *blotted* they appeare.
>
> (*ll* 7–12)

Here Cowley equates his letter with human sinners whose secret transgressions will only be revealed in the fires of the last day, when they have

died (and when the dye of their sins is brought into the light). John Rogers, a Puritan clergyman (who died in 1636), uttered a similar sentiment when he observed that

> no mans Conscience dyes, but lives, and shall meet him at the last day: and though his sins be now as words written with the juyce of Lemmons, nothing to be seen, yet when their Conscience comes to the fire of Gods Judgements, then every little dash, idle words, vain thoughts, &c. will be perceived.[40]

The image was also taken up by George Swinnock, a non-conformist divine, who noted in a 1653 sermon that "things that are now dark and secret, shall be then as clear and apparent as at noon day; the fire of that day will make things legible which are written with the juyce of Lemons."[41] This metaphor encourages us to think that the surfaces of human bodies contain hidden secrets, secrets that will eventually (and shamefully) be revealed to public sight and comprehension. The text of our sins is hiding on our skins, perhaps unbeknownst to us, waiting for the moment when it must come to light. Invisible writing therefore becomes a condition of human existence and a marker of human frailty.

From the gendered narratives of the Wars of the Three Kingdoms, which allowed women to participate in secret correspondence if they overtly proclaimed their apoliticism, to the evocation of sin as a stain hidden on the body, invisible ink helps us to think through the parameters of our own and others' cultural narratives. As a phenomenon that fades as it is written and must be brought to light again by its reader, it exemplifies the collaborative enterprise of letter-writing and of writing *per se*, and draws attention to the imperfectly perceived or invisible aspects of our world. It tells us that our own writing encodes ideas we have not yet fully recognized, but which are already nascent in the words we lay down on the page. I end, then, by emending the opening words of Cowley's lemon-juice poem: "What do *we* write that, as yet, we do not see?"

Notes

1 Jane Short to Thomas Short, London, 20 February [1649/50]: The National Archives, Kew, UK, State Papers 18/9, fol. 1.
2 See John Wilkins, *Mercury, or The Secret and Swift Messenger* (London: John Maynard and Timothy Wilkins, 1641), 42–43. See also David Kahn, *The Codebreakers: The Comprehensive History of Secret Communication from Ancient Times to the Internet* (New York: Scribner, 1967, 1996), 522–523; Kristie Macrakis, *Prisoners, Lovers, and Spies: The Story of Invisible Ink from Herodotus to al-Qaeda* (New Haven, CT: Yale University Press, 2014), especially 1–68.
3 Macrakis, *Prisoners*, 30–38.
4 In the words of Jacques Derrida, "Paper is the support not only for marks but for a complex 'operation'—spatial and temporal; visible, tangible, and

often sonorous; active but also passive. … [It] is utilized in an experience involving the body, beginning with hands, eyes, voice, ears; so it mobilizes both time and space. Despite or through the richness and multiplicity of these resources, this multimedia has always proclaimed its inadequacy and its finitude." See Derrida, "Paper or Me, You Know," *Paper Machine*, trans. Rachel Bowlby (Stanford, CA: Stanford University Press, 2005), 42, 44.

5 "Mary Welsh" to her "good nephew," 12 January 1657/8: British Library, Add MS 4158, fol. 150. See also *A Collection of the State Papers of John Thurloe*, ed. Thomas Birch, 7 vols (London: Fletcher Gyles, 1742), vol. 6, 723–724.

6 Ibid.

7 See *Calendar of the Clarendon State Papers*, 4 vols (Oxford: Clarendon Press, 1869–1970), vol. 2, 365.

8 *Clarendon State Papers*, 2.366.

9 Doreen Cripps provides a good summary of this moment: see Cripps, *Elizabeth of the Sealed Knot: A Biography of Elizabeth Murray, Countess of Dysart* (Kineton: Roundwood Press, 1975), 57–61.

10 See Royal Society Archives, Boyle Collection, RB/25/38, 11–12 ("Pour Escripre a vn amy"); Robert Boyle, *The Works of the Honourable Robert Boyle* (London: J. Phillips, 1699), 521; W. M., *The Queens Closet Opened* (London: Nathaniel Brook, 1655), 2–3, 27, 270–271.

11 Cripps, *Elizabeth*, 59.

12 SP 78/114, fol. 249.

13 SP 78/114, fol. 251.

14 Numerous scribal copies of his letters are contained in SP 78/114.

15 See *Clarendon State Papers*, 4.193, 4.195, 4.233.

16 For biographical information on Inchiquin, see Patrick Little, "O'Brien, Murrough, First Earl of Inchiquin (*c.* 1614–1674)," *Oxford Dictionary of National Biography* (Oxford: Oxford University Press, 2004). Accessed 13 October 2015, www.oxforddnb.com/view/article/20463.

17 Rosalind K. Marshall, "Murray, Elizabeth, Duchess of Lauderdale and *suo jure* countess of Dysart (*bap.* 1626, *d.* 1698)," *ODNB*. Accessed 13 Oct 2015. www.oxforddnb.com/view/article/19601. Lady Dysart was in Flanders with her husband in May 1657 and in France with Inchiquin in September 1658: see *Clarendon State Papers*, 3.298 and 4.97.

18 *Clarendon State Papers*, 3.298; SP 78/114, fol. 249.

19 See Marshall, "Murray, Elizabeth"; Cripps, *Elizabeth*, 60, 67 (Cripps says this pension was awarded on 22 May 1661. However, see SP 44/7/52, which dates the award to 12 May 1662 and orders payments to begin from "Lady last," i.e. 25 March 1661/2.)

20 Inchiquin to "Mrs Gray," 31 July/10 August 1659: SP 78/114, fol. 331.

21 Madame Dysart to Inchiquin, 15/25 August 1659: SP 78/114 fol. 315. "hardin" is almost certainly a code name. It cannot refer to the Royalist courtier, Richard Harding, or a close male relation, since Richard Harding died in 1657, leaving a daughter and no sons: see Geoffrey Smith, "Long, Dangerous and Expensive Journeys: The Grooms of the Bedchamber at Charles II's Court in Exile," in *Court Culture 1642–1660*, ed. Jerome de Groot and Peter Sillitoe, special issue 15, *Early Modern Literary Studies* (August 2007): 1–26.

22 SP 78/114 fol. 342. The warning against over-steeping suggests that Dysart was recommending the use of a solution of powdered gall, writing from which could be activated by washing it over with "calcined copperas," i.e. a copper sulphate solution. This was the recipe used by the marquis of Ormonde's circle (see *Clarendon State Papers*, 3.391), although neither of

these powders can really be called white. Alternatively, a solution of the white powders of alum or sal ammoniac could produce writing that would become visible when dipped in plain water. Recipes for this were common and can be found, for example, in *The Queens Closet Opened* (1655), 270–271.

23 SP 78/114, fol. 349.
24 SP 78/114, fol. 346.
25 SP 78/114, fol. 249v.
26 See Abraham Cowley, "The Mistress," in *Poems: Viz. I. Miscellanies. II. The Mistress, or, Love Verses. III. Pindarique Odes. And IV. Davideis* (London: Humphrey Moseley, 1656), 9–10.
27 Tim Morris, "Cowley's Lemmon: Secrecy and Interpretation in *The Mistress*," *English* 60, no. 228 (2011): 21–41, 40.
28 John Cotgrave's *Wits Interpreter* contains recipes for invisible ink, specifically designed for love letters: see *Wits Interpreter* (London: N. Brooke, 1655), 173.
29 Thomas Paynell, *The Moste Excellent and Pleasaunt Book, Entituled: The Treasurie of Amadis* (London: Thomas Hacket, 1572), Book 10, 260.
30 Kenelm Digby, *A Late Discourse Made in a Solemne Assembly*, trans. R. White (London: R. Lownes and T. Davies, 1658), especially 6–25.
31 Invisible ink letter from Charles II, inside a letter from Lord Newburgh to Lord Balcarres, 4 October 1653: Bodleian Library, MS Rawlinson A 6, fol. 415b.
32 Invisible ink letter from Lord Newburgh in Paris, written on the back of a letter dated 4 October 1653 from "Will. Carter" to an unknown correspondent: Bodleian Library, MS Rawlinson A 6, fols 402–403.
33 TNA, SP 18/9/1.
34 That is, if an enemy combatant were captured with official orders he would be taken as a military agent, not a spy, and would therefore not be subject to summary execution.
35 Bodleian Library, MS Rawlinson A 4, fol. 313.
36 See *Clarendon*, 4.617.
37 Morris, "Cowley's Lemmon," 35.
38 See the early modern English translation: François Rabelais, *The Second Book of the Works of Mr Francis Rabelais* (1653), Chapter 24, 157–160.
39 Robert Boyle discusses one such recipe in *New Experiments and Observations Touching Cold* (London: John Crook, 1655), 840–845.
40 John Rogers, *A Godly & Fruitful Exposition Upon All the First Epistle of Peter* (London: Peter Cole, 1650), 469.
41 George Swinnock, *Men Are Gods, or the Dignity of Magistracy* (London: Nevil Simmons, 1660), 276.

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11 Real-Life Cryptology

Enciphering Practice in Early Modern Hungary[1]

Benedek Láng

Ciphers in Action

Among historians of cryptology, the discrepancy between the content of the sixteenth- and seventeenth-century handbooks and the actual encryption practices of those times is well known. As David Kahn pointed out in 1967, the books written by Gustavus Selenus, Athanasius Kircher, Blaise Vigenère, and others "have a certain air of unreality about them." "The literature of cryptology was all theory and no practice," Kahn writes, and "the authors did not know the real cryptology that was being practiced in locked rooms here and there in Europe."[2] Indeed, the *Polygraphia* and *Steganographia* by Johannes Trithemius,[3] the *De occultis literarum notis* by Giambattista della Porta,[4] the *Cryptomenytices et cryptographiae libri IX* by Gustavus Selenus, who was the famous library founder Duke August of Braunschweig,[5] the *Traicte des Chiffres* by Blaise Vigenère,[6] and the *Polygraphia* by Athanasius Kircher[7] contained sophisticated polyalphabetic and syllable methods, while all ciphers in the fifteenth to seventeenth centuries that were actually used (that were more complex than a simple monoalphabetic substitution) fell under one category that is hardly mentioned in these books: the homophonic cipher.

Homophonic cipherkeys assign homophones to each letter of the plaintext to make frequency analysis hard, special characters for double letters and syllables, nullities (characters without a meaning to confuse a codebreaker), and finally, a nomenclator table, or a list of code words that stand for the most common geographical names and political actors in order to resist the "probable word attack." The "probable word attack" is the search for a word that is most probably found in a plaintext, which can be used first to find a pattern in the ciphertext.

This essay surveys the discrepancy that extends between the homophonic method as a theory and its application in real life. I argue that early modern cryptographical practice cannot be understood merely on the basis of how homophonic methods are supposed to be applied; one needs to look deeper at the sources to see how they were actually used in everyday situations. In order to document such real-life situations, I will

refer to the rich source materials of early modern Hungary. While the history of Hungary in the sixteenth and seventeenth centuries is neither necessary nor possible to summarize here,[8] it might suffice to refer to the historical reasons for the large number of encrypted messages in the archives. This region became a clash zone in the centuries of the early modern period: Christian and Ottoman armies fought, Western culture was confronted by Islamic culture, Catholicism was challenged by the Reformation, and, to a certain degree, Western Christianity met Eastern Christianity. At the end of the fifteenth century, travelers saw Hungary as a rich and safe place, but by the middle of the sixteenth century, it was a complex system of regions in coalition and rivalry. The country had been broken up into three parts: the Hungarian Kingdom ruled by the Habsburgs, the central part of the country occupied by the Ottoman empire, and in the eastern part, Transylvania, which started semi-independent life as a vassal state of the Ottoman empire. These parts were not stable: borders were constantly changing, and two-thirds of the population lived in border regions. In this unstable, eventful region it was especially important to hide and discover diplomatic, military, scientific, and religious secrets.

The sources relevant to the history of cryptography in early modern Hungary are scattered in the archives, mostly unidentified and unpublished. Catalogs often fail to mention that a few paragraphs of a text are written in a cipher. A few code key collections containing dozens of *claves* from the history of Habsburg diplomacy, Hungarian family correspondences, and anti-Habsburg uprisings, however, are exceptions to the rule.[9] Apart from these concentrated collections of cipher keys, it is generally true for many other keys and the letters themselves that one needs a lot of effort, good luck, and the help of other researchers to be able to identify them. My research was based on nearly 300 code keys that survived mostly in manuscripts and more than 1600 ciphered letters. About 400 code keys are in unpublished manuscripts, and the rest are published. I have included a considerable number of "external" sources and comments that are connected to the various forms of ciphering, especially cryptology, but are not themselves coded. Uncovering this source material—comprising both handwritten and printed texts, originating from both archives and libraries—was the most laborious part of my research.

The great variety of languages used in these sources is a distinct feature of the Hungarian sources. The powerful and long-lasting presence of Latin in all of the Central European region is widely known. Latin was the language of home and foreign affairs, science, diplomatic, and military correspondence, and it was even used by people arguing for the national languages. German was common in the countries of the Habsburg empire—diplomats and captains of German origin naturally liked to write in their mother tongue, in the same way as Hungarian was preferred

by Hungarian nobles among themselves. Spies, typically of Serbian and Bosnian origin, sent their reports in Italian from Constantinople or Ragusa via Venice to Vienna, while the Italian language was gaining importance as the language of the homeland of diplomacy and secret writings. Turkish was present due to the Ottoman oppression. French was also surprisingly popular, even dominant at times, and not only when the leader of the anti-Habsburg appraisal, Ferenc Rákóczi II, was negotiating with his ally, Louis XIV, but also in his letters to his Polish supporters.

Sharing, Changing, and Using the Cipher Key

A recurrent theme in early modern Hungarian military, political, and diplomatic correspondence is the use, or improvement, of cryptography and all the entailing problems. Political actors often noted that without a proper cipher key, they were not able or not willing to write about things that really mattered. The Transylvanian magnate, Dénes Bánffy, who was writing to the Transylvanian politician Mihály Teleki, noted that "Since I have no clavis, I do not dare to write, because if my letter were caught, they would know that we were betraying our lord and our nation, and that we are asking for money for this reason."[10] Bánffy writes again, in another letter, "Do not fail to send the clavis because there is no correspondantia without it."[11] Prince Ferenc Rákóczi II, leader of the famous anti-Habsburg independence fight (1703–1711), wrote to his correspondent in 1711 from Gdansk, "I do not dare to write without a clavis."[12]

There were several ways to exchange the clavis. They were often sent together with the ciphered letter, sometimes by a separate courier, or occasionally a personal meeting was arranged, this being the most secure option, of course. Archbishop György Lippay sent the clavis in an attachment to his letter to prince György Rákóczi in 1637 from Vienna. The clavis itself has survived too:[13]

> in order to carry it out more appropriately, I am sending Your Lordship the clavis too. There are things I would be happy to share with Your Lordship. If Your Lordship had received this clavis, I might be able to write more.[14]

Rákóczi reacts assuring that he has received the key, noting that "I took the letter and the clavis included in it from the man of the voivode four days ago."[15] Then, once more a few days later: "We received your letter four weeks ago from the man of the voivode dated from July 16, together with the clavis."[16]

A proper usage of the exchanged claves required clear identification and reference. Ciphers were often named after the sender or the addressee, supposing (rightly or not) that the given person was only using one ciphered channel of correspondence: "We have written this letter with the

clavis that Lord Szalai has."[17] "I have used the clavis of Lord Absolon."[18] "I have written to Your Lordship with the clavis of Lord Fajgel."[19]

In other cases the keys are described less precisely. Teleki notes that "I have written to Lord Simon Kemény the names with the clavis that Your Lordship has sent me, I wonder if you know which one I am talking about."[20] Jónás Mednyánszky's instructions on his message for the Transylvanian noble (later prince) János Kemény were hardly explanatory: "Your Lordship can understand it using the clavis that our lord owns."[21] Since the ciphered parts of this letter had not yet been decoded, one suspects that the one-time addressee could make no sense of the faint reference either.

Sharing the key was a need discussed often in the letters, but its usage was hardly problem-proof. Rákóczi mentions such problems several times—he obviously had a great deal of experience exchanging keys. In 1711 he sends the following letter:

> Since Your Lordship has written to me once again with a clavis that *praevie* I have told Your Lordship about, that Károlyi also has a copy, I am not sure whether the clavis that Lord Vay had resigned to you in a table is not lost. Until I hear confirmation that Your Lordship has received it, I cannot write any more *particularitas*.[22]

Bishop György Lippay and Prince György Rákóczi could not successfully share the key either, according to their 1637 correspondence—the prince finds a mistake in the clavis he was sent by the bishop, upon which Lippay, who cannot find any fault with it, asks him somewhat indignantly to mend it quickly so they can use it. "Your Majesty did not wish to use the clavis I had sent and had found some fault in it that I still cannot see," he writes,

> but if there was one, Your Majesty could correct it and send me a copy, perhaps my humble service had not been useless to Your Majesty, I do not wish to be of nuisance to Your Majesty. I remain to be full of good intentions.[23]

Three days later he repeats the request: "I have written about that clavis by the courier, please, Your Majesty, correct it and *cum correctione* send me a copy."[24] It is impossible to prevent all complications, but it is exemplary how careful chancellor Miklós Bethlen is when he gives orders on sharing the key as well as about what to do if the addressee happens to pass away. "I have sent Harsányi a clavis too, in case he will need it," he instructs. Continuing, he notes that

> I have told my messenger who he should deliver the letter to in case Harsányi had died in the meantime. Your Lordship may see the short *instructio* that I have given to him. *Pro sua prudentia* instructs Your Lordship too. All about these *coram plura*.[25]

After a key was successfully shared and smoothly used for a while, it was time to think about how to replace it with a newer one. The longer it was used, in more letters and in more relationships, the easier the job of the potential codebreaker, who would have more materials to identify breaking points. One would expect the expert cipher-users of the early modern period to do all they could to avoid this danger. It is surprising, however, that the question of replacing a cipher is rarely mentioned in the letters. Updating a cipher to prevent enemy eavesdropping seems to have been of little interest to early modern Hungarian political actors. Security was surprisingly neglected in this respect. Correspondents were not careful to use a clavis with one particular person only, and they did not aim at replacing the claves at least yearly, either. For example, prince Ferenc Rákóczi II's envoys to Constantinople, János Pápai and Ferenc Horváth, had written several dozen almost completely enciphered letters during the year 1706. For these, they had used a table[26] that was so important that it has survived in several copies in the secret archives of the prince and in the Ráday Archives.[27] If one looks at this pack of letters closely, one sees that three of them begin with similar combinations of numbers.[28] The two following letters, almost completely enciphered, are particularly long.[29] Had a Turkish codebreaker captured the package, he would have found ample resources to use the appropriate analyses and locate regularities that would aid codebreaking. Pápai even used the same table when writing to another correspondent, Ádám Vay.[30] What is more, the envoys were still using this key in the following three years from Belgrade and Constantinople, despite the change in the diplomatic circumstances.[31]

This clavis is undoubtedly one of the most important tables of the eight year-long freedom fight (1703–1711) that prince Rákóczi fought against the Habsburg ruler of Hungary. Scholars know this not only from the fact that Rákóczi's diplomatic relationship with Constantinople was a highlighted relation, but also from the fact that, altogether, three tables survived the freedom fight that were also copied onto parchment, Pápai's table being one of these.[32] The other table surviving on parchment signals Rákóczi's most distinguished diplomatic goal, a cipher used in the correspondence with Louis XIV and his court, and the third one, bearing no name, was used with his secret lover in Poland.[33] However central this table could have been in the prince's correspondence, it was still highly dangerous to use it for five long years in several cities and with several partners. With this knowledge in hand, we should hardly be surprised to learn that after his freedom fight terminated and he felt forced to leave the country for Poland, the fleeing prince took this clavis out again, when he was hard pressed without claves that the addressees would also have a copy of. Wanting to share private information in letter, he suddenly remembers that he could start using Pápai's table again in his correspondence with Ádám Vay, too:

> Although I would have liked to inform You *circumstantialiter*, I did not dare to write without a clavis, but then I was reminded by Pápai's

> letter that we can use his old clavis from Constantinople, which I am using right now; and since I do not doubt his faithfulness, he could decipher this message himself.[34]

Both parties involved in an enciphered correspondence complained that encryption and decryption were time-consuming and tedious tasks. An average homophonic table of about three to four hundred items, and an encrypted message of average length (made up of four or five paragraphs), requires transcription of every letter and the corresponding numbers. This monotonous job can take a long time even with a shorter letter. Decryption is an even longer process, most of all because the clavis usually lists the letters of the open text in alphabetical order, aiding the encryption but not so much the decryption. This is the reason why certain writers only encrypted some of the words or parts of the sentences. Mihály Teleki wrote: "I had no time to decipher our lord's letter since I only received it in the evening and I had to leave early at dawn."[35] Rákóczi writes to his general, Bercsényi: "I realized at last that you must have found deciphering these letters very boring, since even their summary is annoyingly long for me to read."[36] He also asks Sándor Nedeczky, his envoy to Russia, in vain to use the clavis properly and not to mix coded and uncoded letters in the same word.[37] Without a secretary, Nedeczky finds this work too tiresome and asks his partners not to "ruin him in the future" and "only encipher *secretum*, leaving the rest open."[38] Simon Kemény makes a similar request to Teleki in 1662.

> By God, I am asking Your Lordship to write only what is important, and only *breviter*, and not to write such horribly long *pandechta*, enciphered, and with a lot of mistakes, because with the ambassador being here we have so much to do we can hardly get any sleep.[39]

Leader of the anti-Habsburg upraising, Imre Thököly, writes in his diary: "I have spent most of the night deciphering texts, and when I have finished revising them, I called for the French lord."[40] Deciphering required a long night's work more than once. This example is informative not only because it contains the usual complaint about the tiresome work of enciphering, but also because of its (lack of) reference to the cryptologist. Normally, decryption was a skill practiced by a specialist, a servant or a secretary who was expert in cryptography. Sometimes the name of the specialist who "translates" the clavis is revealed within the correspondence. One cannot quite expect powerful politicians to labor for hours on the arduous job of deciphering. It is all the more surprising when we hear that noble leaders of different anti-Habsburg movements, such as Imre Thököly or Ferenc Rákóczi II, regularly did so.[41]

Cautious and Reckless Encryption

A general experience of the history of cryptography is that cipher systems are broken successfully not because they are weak but because they have not been used properly. The options they offer are not exploited fully, and they are used carelessly or incorrectly.[42] The Hungarian sources contain a number of direct and indirect information about how clerks were aware of the danger threatening ciphered content, how they tried to protect their ciphers from being found out, or how they made them withstand the attempts of the codebreakers. However, such information from the sources is highly ambiguous: there are many signs implying that cipherers were careful, and there are also signs that they did not have the faintest idea how they were making their ciphered texts vulnerable.

A number of homophonic tables assigned a special sign for the numbers and the names of the months. This was wise because almost every message contains dates, which are in a special place (at the end or beginning of the letter), and if a codebreaker finds several letters, regularities can be identified as easy breaking points. If information had also been gained from traffic analysis (showing which letter was mailed in which month), the codebreaker would have had a reliable anchor with which to identify the months. If, however, the names of the months are not coded letter by letter, but each month gets a number code, then the codebreaker cannot use this as a breaking point. The same goes for salutations, greetings, or the name of the addressee, all of which can be easily identified by traffic analysis. Assigning separate characters to these in the code table is a sign of cautious and wise behavior. For example, Mihály Teleki completely enciphered his letter to Mihály Apafi, leaving the date as an open text.[43] Why bother enciphering the date and the signature when a potential codebreaker knows who had sent the letter and when? There is no danger in giving the reader information already known, but it would be unwise to offer a part of the text that would be easy to guess because that would also open a path into identifying certain characters. Teleki realized the paradox that leaving certain parts open actually increases the level of security.

While there are numerous examples of ciphering with a careful attitude, there are also as many signs of reckless and senseless behavior in the archives. János Pápai, Rákóczi's ambassador in Istanbul—a center partly, but not entirely in alliance with the fighting Hungarian prince—changed the key of his letters to Rákóczi dangerously seldom. However, he wrote quite a lot to the prince with abundant ciphering. It would not have been the least surprising if the Turkish secretaries had stopped and copied his letters. Had they compared only three successive letters, which the key indicates all begin with the greeting "Your Lordship," they would surely have discovered that the number sequences at the beginning of the letters are always almost the same, and it would not have been a difficult task to guess what they mean.

Ke. gy. el. me. s. Ur. am.
133. 39. 32. 273. 80. 205. 61[44]

Ke. gy. el. me. s. Ur. am.
133. 39. 364. 32. 273. 308. 205. 61[45]

Ke. gy. el. me. s. Ur. am.
133. 39. 32. 273. 80. 205. 61[46]

Ke. gy. el. me. s. Ur. am.
133. 39. 32. 273. 80. 205. 61[47]

As this example shows, the danger was not that readers would figure out who the addressee was, which was known well in advance, but that the broken passage is a promising clue with which one can attack the remaining, more valuable and more private parts of the ciphered message.

The same danger threatens when one thoroughly compares letters from the rich correspondence of Rákóczi with his Polish partners. Containing 450 codes, this encryption was the most elaborate table of the freedom fight.[48] But the sophisticated method is useless, as forty of the letters start with the encoded form of the same phrase: "a Danzik, le 20 Février, Monsieur" (where of course the date varies). As the key is homophonic, the particular number sequences differ; however, the corpus is large enough for a skillful adverse agent to correctly identify the numbers corresponding to the same syllables and letters.[49] Even nullities do not pose much difficulty, because the writer of the letters always inserted them at the end of the rows. With such recklessness neither the homophonic system, nor the use of pseudonyms (Nathanaél Sylver or Pompeio Cesoni), makes Rákóczi's messages difficult to uncover.

Sand in the Machine

The most frequent and practical problem in the more than 1600 letters analyzed in my research is the absence of the key for the coded message. Such questions often arise:

> Your letters written with clavis have arrived to my hands, my Lord, but I could not proceed with them happily, as the clavis You used was not given or sent, thus I am blind in their many terms to this day.[50]

In another letter, the writer remarks that

> My dear Lord Brother, I was unable to read the whole letter which You have recently sent by post, since it is not written in that note which You have left here. These are the unknown words: 020, 550207, 4y04, 9100, 1, I do not have these.[51]

In other cases the problem is not the absence of a clavis but that the sender or the addressee is unsure which one to use for the coding or the

decoding: "Regarding the question of the clavis I have no clue, my Lord; for I have written using two different claves to You, and I do not know which one You understand." The writer continues, explaining that the

> clavis of mine which was with You I am going to tear up and destroy completely; I have written this letter with the clavis of Lord Fajgel. It would not be secure to send the ciphered letter together with the clavis. Please make a new one, let us use that from now on.[52]

And again:

> My Lord Bocskai had sent the letter included here. Although I tried eight or nine different claves, I was unable to read it. Please send it back from my Lord Gyulafi, maybe you can decipher it, or perhaps it is written using that big old clavis of which I have no copy.[53]

Even in the background of these complications, it must have been an exceptional case when prince Rákóczi was unable to decide if some "suspicious" letters were written "with clavis or simply in Polish."[54]

Occasionally, the addressee writes back to a letter—with some amount of reproach—that he is unable to read the ciphered message: "Lord Szepesi wrote the clavis full of mistakes; especially the part about Lord Szalai I was unable to make out, and the end of the parchment which You had written. The rest I could figure out."[55] Such reproaches often do not lack humor: "What kind of gold did You write about in the postscript, with nice things about it, I could not penetrate your writing. At such times I wish that You were writing to me without clavis."[56] A not so courteous reproach to Teleki is equally funny:

> Your witchlike writing caused us awful puzzlement. You wrote about so many things, as we spell out one, we forget the other. It has a start somehow, yet in the end it becomes like the bulls of Kővár let loose on the hillside.[57]

Miklós Bethlen also does not shy away from reproaching Teleki, noting that

> The Palatine's wife could never read Your letter, neither could I, and if you write to me more in this way, I will still not be able to, not even if I put twelve glasses on my nose. It was a cipher indeed – maybe you could not have read it yourself. Next time be sure to write more orderly, if you want anyone to make out a word of it.[58]

From another letter: "I cannot make the cipher out. What do You want me to buy: knives, goats or sturgeons?"[59] We also find an example of a subtle sense of humor in the following, where Rákóczi asks his envoy

János Pápai in a letter from Miskolc to refer to the Porte for permission to invade Szeged.[60] However, the Prince's chancellor must have made a mistake in ciphering the name of Szeged, as Pápai, in his coded answer, jokes about it. Despite the incorrect encoding he perfectly knows which city the message refers to, but he still writes,

> Your Majesty commands, as we interpret, that we ask the Vizier to … allow Your Majesty to invade Szrülavár. We were really curious to find this place on the map, but we have not found such fortification, we do not know anything similar under the Hungarian Crown, so we cannot act accordingly. If, however, Your Majesty wishes to have permission to invade Szeged, since it is not yet under Your Majesty's protection, we judged it to be unnecessary to ask permission from the Turks.[61]

Sometimes it is not evident which party makes (more) mistakes. In such cases the correspondents can mutually blame one another. Here, Dénes Bánffy blames Teleki: "You are writing about the deficiencies in my usage of the clavis – perhaps there were a few, but in fact it is the blind laughing at the sightless. *Turpe est doctori.*"[62] It is through such examples that the difference between the theory of cryptology and its meticulous everyday application can be grasped.

Breaking the Code

Decipherers in the early modern period in Hungary did not always take the necessary precautions to avoid the secret message coming to light. Did the enemy take advantage of their carelessness? What kind of codebreaking professionals and offices were formed in the past to break the cipher texts of the enemy, and what tools did they use? My essay has thus far focused on the process of decryption by the intended reader, but attention should also be paid to the tools applied by the enemy, who does not have the key and wants to reconstruct it. What did the science of cryptanalysis and codebreaking look like in Hungary in the early modern period? This topic is inherently more discreet, so there are obviously fewer sources, data, or notes related to it than other areas of ciphering.

Codebreaking handbooks of the age available for average readers did not contain the most up-to-date decryption methods and rather concentrated on outdated, monoalphabetic ciphers with obvious word-boundaries[63] or simpler homophonic methods.[64] The most up-to-date handbooks able to attack proper homophonic ciphers were only available for a privileged few among the political elite, and they were often available only in manuscript form, not in print.[65] There is also no indication in the early modern Hungarian sources that any cryptanalytic handbooks were used. Codebreaking methods included torturing

the messenger or stealing the key instead of reconstructing it. Many of the claves used in the anti-Habsburg Wesselényi movement, for example, were outdated monoalphabetic ciphers[66] that the Habsburg court could easily have broken. Still, there is no source indicating that anyone bothered with codebreaking. It seems from the documents that they focused solely on intercepting the keys as the main method of mopping up the organization.[67]

Dénes Bánffy confesses to opening the letters of both the emperor and the bishop only in a ciphered part of the letter, here typeset in italics:

> So what is the fruit of my Lord, the bishop of Vácz going in? Was he afraid? Inexperienced? Was he faking it? He has taken the side of the Turks with much zeal, and forces His Majesty to take the praesidium from the fortresses, because Pasha Ali had sent a message saying he was going to buy all of them, so that is going to be the end of Transylvania; *and all of these things I have learned when I cut open the letter to the bishop, and took out from the envelope the letter to the emperor also, and broke these ciphered letters so we could send them to Your Lordship.*[68]

There are only a few references that suggest that the cipher itself was investigated. In 1706, Rákóczi reports in his confessions that he had learnt about the emperor's instructions to Rabutin through a ciphered letter that he had broken himself.[69] He also mentions the capture of a secretary of the enemy in 1708, who happened to carry a cipher key to general Heister. There remained at least ten German claves written in Gothic letters in the archives of the freedom fight that contained secret information from the Habsburg Court. The prince's secretaries presumably reconstructed some of these through captured letters and not through captured keys; some are not advanced and so may have been successfully broken.[70] István Szentpáli, envoy of György Rákóczi I, writes about how the Turks can break the prince's cipher: "they had broken the clavis Your Lordship uses with János Kemény with the help of intercepted messages, so this had better been replaced."[71] Let me quickly emphasize, however, that this does not make the Turks advanced codebreakers–prince György Rákóczi I employed a highly outdated monoalphabetic method of ciphering when corresponding with his ambassadors.

Advanced vs Outdated?

The question arises: how sophisticated was Hungarian cipher-use compared to the cryptologic technology of Europe at the given time? The first impression might be positive. Comparing the best tables of the Rákóczi freedom fight to those of the chancellery of the Habsburg court, for example,[72] of the papal diplomacy,[73] or the French court,[74] one sees that

they are not inferior in quantity (of numbers assigned to letters, syllables, and nomenclatures), nor in structure (since they were carefully designed homophonic systems complemented by nullities). It is also worth noting however, that the most advanced practices of the prince's diplomatic correspondence were influenced by the French. It was the tables sent by the French court that helped Rákóczi catch up with the rest of Europe in this respect. In the seventeenth century, Antoine Rossignol, mathematician-cryptographer of Richelieu and then of Louis XIV, developed an enormous homophonic system of 590 items that coded syllables. The "Grand Chiffre," as it later became to be known, was a puzzle to everyone for the next two centuries, until Étienne Bazeries (1846–1931).[75] The 'Sun King' of course did not offer this unbeatable system to his Eastern ally, but he shared their second most advanced one, which was still considered one of the most sophisticated tables of the time.

In Rákóczi's environment, many envoys received claves that were developed according to the French system, just like the table of Pápai discussed above, but the locally used codes of the freedom fight remained surprisingly primitive. The 1705 clavis of general Sándor Károlyi and general Miklós Bercsényi, for example, was not only monoalphabetic; it also used graphic signs. Using these obviously did not help fast and clear communication on the battlefield. It is wearisome to draw a square instead of the letter 'a', a triangle instead of a 'b', an 'm' sign with a cross at the end instead of the letter 'e', but one should also consider how much more difficult it is to look up those signs from a table that cannot be ordered logically in any way, as opposed to consecutive numbers.[76] Still, there are a number of letters proving that this very impractical table was indeed used.[77] Similarly monoalphabetic and consisting of signs are the messages of Mihály Hentér, ambassador in Constantinople, that were sent to the prince in 1707.[78] To put it simply, the enciphering practice of the prince's diplomacy was not uniformly developed: higher-level ciphers were used internationally, less advanced ones internally.

Another feature of Hungarian ciphering practice was that it advanced more slowly than in Western Europe, and even toward the middle and end of the seventeenth century, shockingly simple methods were used to cover information in life-and-death situations. In 1637, prince György Rákóczi I was jovially writing to his envoy:

> We would like to write more, but we cannot put it down in writing, so we are sending you a clavis that we are going to use in the future. Basically you only have to write down the letters from the bottom row instead of the ones in the top row and vice versa.[79]

In other words, the prince is offering a cipher that mutually assigns the second half of the alphabet to the first half. No nomenclatures, no nullities, no syllables, no homophones.

Of course, it would be misleading to make the impression that in contrast with Hungary, Western Europe had a consistently high standard of ciphering. On the contrary, while the majority of the claves were certainly of a high standard, readers can find surprising exceptions. In 1621, Ferdinand II, Holy Roman Emperor, exchanged letters with Jacobus Curtis (Jakob Kurtz), his Polish trustee, using a monoalphabetic clavis.[80] In 1628–1629, Johann Ludwig Kuefstein, ambassador at the Porte, wrote to Emperor Ferdinand III with a cipher of graphic symbols (and he did so using a weak, homophonic, but practically monoalphabetic system).[81] Likewise, in 1632, the Emperor's secret reporters, or spies, coded their Italian letters with a clavis of graphic symbols.[82] Sixty years prior to this, it was an accepted method in the Imperial administration to use graphic symbols (see Carolus Rym's letters from Constantinople around 1571),[83] but the seventeenth century is dominated by the use of the more comfortable numbers. One could make a long list of similar exceptions that prove that development was not linear (from simple monoalphabetic substitutions to the more complex homophonic methods) in the court of the Austrian Emperor either, and that historical figures had different meanings for the terms "improved" and "practical" when it comes to ciphering.

By the end of the early modern period, the usage of ciphers in Hungary had generally caught up with the Central and Western European standard. This, however, was mainly influenced by Western practice itself. The letters from the correspondence of Transylvanian princes reveal that by the middle of the seventeenth century, ciphering practices in the Principality of Transylvania were on a less complex level (using simple monoalphabetic ciphers) than those of the envoys of the Habsburg (who primarily employed homophonic methods). In addition, the fact that the Princes tended to do the coding themselves—something that György Rákóczi I, Imre Thököly and Ferenc Rákóczi II felt so natural—is not a practical usage of ciphering. Even a developed method can be used in an undeveloped way. Hungarian ciphers were fragile not because they were structurally weak but because they were not used properly. The options they offered were not exploited fully, and they were used carelessly or incorrectly. Yet they were usually safe. However, they were safe not because they were used with care, taking advantage of the given methods, but because cryptanalysis was also underdeveloped.

Conclusion

The letters quoted in this chapter (and in other sources)[84] are useful for historians not only to uncover political and military secrets (as is usually done in the secondary literature), but also to reconstruct the historical actors' attitudes toward the cryptographic technology. How much they understood the functioning of a method, whether they realized

how important it was to protect the key, how they exchanged claves, how often they replaced them, and what practical problems they were faced with are questions seldom raised by scholars. Particularly relevant is to see how difficult it was in early modern Hungary to decipher a homophonic code, at least based on the sources available. The process in which enciphering techniques spread and became common might have been linked to the fact that people from all walks of life suddenly found themselves in the center of political crashzones and were forced to own and pass on secrets in the information network, as Hungary fell into three parts. The post-1711 phase sees a decline in cipher-use as politics become quieter and military conflicts cease, though this is exactly the time of a rise in literacy.

Notes

1 My research was supported by the EURIAS fellowship at the Collegium de Lyon and the grant OTKA K 101544. The English version of the essay is based on Theodora Király's translation of my Hungarian manuscript. Translations of the documents are our own. The quoted documents are plaintexts, unless otherwise is noted.
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3 Johannes Trithemius, *Polygraphiae libri sex* (Oppenheim: Haselberg de Aia, 1518), *Steganographia: ars per occultam scripturam* (Frankfurt: Becker, 1606).
4 Giambattista Della Porta, *De furtivis literarum notis vulgo de ziferis liber quinque* (Naples: Johannes Baptista, 1602), *De occultis literarum notis, seu artis animi sensa occulte aliis significandi* (Strasbourg: Zetzner, 1606).
5 Gustavus Selenus, *Cryptomenytices et cryptographiae libri IX* (Luneburg: Sternen, 1624).
6 Blaise de Vigenère, *Traicte des Chiffres* (Paris: Abel l'Angelier, 1586).
7 Athanasius Kircher, *Polygraphia nova et universalis* (Roma: Typographia Varesij, 1664).
8 Géza Pálffy, *The Kingdom of Hungary and the Habsburg Monarchy in the Sixteenth Century* (Boulder, Colorado–Wayne, NJ: Center for Hungarian Studies and Publications, Inc., 2009).
9 National Széchényi Library (OSZK) Quart. Lat 2254; Vienna, Haus-, Hof-, und Staatsarchiv (HHStA) Staatskanzlei Interiora Kt. 13–16. Chiffrenschlüssel and Ung Act. Spec. Fasc. 327. Konv. D. Chiffres 1664–1668. I thank István Fazekas and Géza Pálffy for calling my attention to these sources. National Hungarian Archives (MOL) P 1238 Teleki Mihály collection and G 15 Caps. C. Fasc 43 and 44.
10 Teleki, Mihály, *Levelezés* (*Correspondence*), vol. 4 (Budapest: Magyar Történelmi Társulat, 1905–1926), 297–98.
11 Teleki, *Levelezés*, 4.461–463.
12 *Archívum Rákóczianum*, I., vol. 3 (Rákóczi Archives) (Budapest: MTA, 1873–1935), 698–701.
13 Magyar Történelmi Tár (Hungarian Historical Records) (Pest: Magyar Tudományos Akadémia, 1855–1934) III/5, 146, 34.
14 Ibid., 144–46.
15 Ibid., 280–81.
16 Ibid., 283–84.

17 Teleki, *Levelezés*, 8.249.
18 Ibid., 8.433–435.
19 Ibid., 8.68–69.
20 Ibid., 2.262–264, 1.389–390.
21 Magyar Történelmi Tár II/6, 86–89.
22 *Archívum Rákóczianum*, I., vol. 3, 673–74.
23 Magyar Történelmi Tár III/5, 286–90.
24 Ibid., 291–92.
25 MOL P. 658, 2, cs. 367, and Teleki, *Levelezés*, 6.110–112.
26 MOL G 15 Caps. C. Fasc 36, fol. 1–29 and MOL G 15 Caps. C. Fasc 36, fol. 1–2—fol. 80–82.
27 Ráday Archives C64-4d2-25, 12, no., MOL G 15 Caps. C. Fasc 43.
28 MOL G 15 Caps. C. Fasc 36, fol. 9–10; 11–12, 13–15.
29 MOL G 15 Caps. C. Fasc 36, fol. 13–22.
30 MOL G 15 Caps. C. Fasc 33, fol 35–38.
31 MOL G 15 Caps. D. Fasc 80; Caps. E. Fasc 109; Caps. F. Fasc 160; Caps. H. Fasc 226.
32 MOL G 15 Caps. C. Fasc 43.
33 Benedek Láng, "Shame, Love and Alcohol: Private Ciphers in Early Modern Hungary," *Cryptologia* 39, no. 3 (2015): 276–87.
34 MOL G 15. Caps. H. Fasc. 253.
35 Teleki, *Levelezés*, 8.228–229.
36 *Archívum Rákóczianum*, I., vol. 3, 19–20.
37 Gyula Benda, *Ráday Pál iratai* (Writings of Pál Ráday), vol. 2 (Budapest: Akadémiai, 1961), 227.
38 Benda, *Ráday Pál iratai*, vol. 2, 313.
39 Teleki, *Levelezés*, 2.271–272.
40 Nagy Iván, ed., *Késmárki Thököly Imre naplója, 1693—1694* (Thököly Imre's diary) (Pest: Eggenberger Ferdinánd, 1863), 43.
41 Nagy, Késmárki Thököly Imre naplója, 298–99.
42 David Kahn, *The Reader of Gentlemen's Mail: Herbert O. Yardley and the Birth of American Codebreaking* (New Haven, CT: Yale, 2004), xvi.
43 Teleki, *Levelezés*, 8.240–241.
44 MOL G 15 Caps. C. Fasc 36, fol. 3–4.
45 MOL G 15 Caps. C. Fasc 36, fol. 9–10.
46 MOL G 15 Caps. C. Fasc 36, fol. 11–12.
47 MOL G 15 Caps. C. Fasc 36, fol. 13–15.
48 MOL G 15 Caps. C. Fasc 44.
49 MOL G 15. Caps. C Fasc 39.
50 Teleki, *Levelezés*, 6.394–398.
51 Ibid., 1.220–221.
52 Ibid., 8.543–547.
53 Ibid., 4.176–178.
54 *Archívum Rákóczianum*, I., vol. 3, 75–78.
55 Teleki, *Levelezés*, 8.310–312.
56 Ibid., 5.126–127.
57 Ibid., 7.140–142.
58 Ibid., 3.594–596.
59 Quoted in Zoltán Révay, *Titkosírások. Fejezetek a rejtjelezés történetéből* (Ciphers, Chapters from the History of Cryptology) (Budapest: Zrínyi Katonai Kiadó, 1978), 76.
60 Benda, *Ráday Pál iratai*, 502.
61 Quoted in Benda, *Ráday Pál iratai*, 505. Pápa's answer: G. 15. Caps. C. Fasc 36 (fol. 27v).

62 Teleki, *Levelezés*, 2.244–247.
63 Aloys Meister, *Die Anfänge der modernen diplomatischen Geheimschrift*, (Paderborn: Ferdinand Schöningh, 1902), 61–63. Augusto Buonafalce, "Cicco Simonetta's Cipher-Breaking Rules," *Cryptologia* 32 (2008): 62–70. For Simonetta, see also: Marcello Simonetta, *The Montefeltro Conspiracy: A Renaissance Mystery Decoded* (London: Doubleday Books, 2008). Antonio Maria Cospi, *L'interpretation des chiffres ou reigle pour bien entendre et expliquer facilement toutes sortes de chiffres simples* (Paris: Courbes, 1641).
64 Peter Pesic, "François Viète, Father of Modern Cryptanalysis – Two New Manuscripts," *Cryptologia* 21, no.1 (1997): 1–29.
65 J. P. Devos and H. Seligman, eds. *L'Art de Deschiffrer: Traité de Déchiffrement du XVIIe Siècle de la Secrétairerie d'Etat et de Guerre Espagnole* (Belgium: Université de Louvain, 1967); see also H. Seligman, "Un traité de déchiffrement du XVIIe siècle," *Revue des Bibliothèques et Archives de Belgique* 6 (1908): 1–19.
66 HHStA Ungarische Akten Specialia Verschwörerakten VII. Varia, Fasc. 327. Konv. D. Chiffres 1664–1668, fol. 1–61. See also MOL E 199.
67 Pauler Gyula, *WesselényiFerencz nádor és társainak összeesküvése: 1664–1671*, vol. 2. (Palatine Wesselényi Ferenc's conspiracy, *1664–1671*) (Budapest: Akadémia, 1876), 133–34 and 165–66.
68 Teleki, *Levelezés*, 2.309–311.
69 Zoltán Révay, *II. Rákóczi Ferenc és korának rejtjelezése (XVIII. század)* (Cryptology of the era of Ferenc II. Rákóczy), 14 and 98.
70 MOL G 15 Caps. C. Fasc 43.
71 Beke Antal and Barabás Samu, eds., *I. Rákóczi György és a porta* (Rákóczi György I. and the Porta) (Budapest: MTA, 1888), 704.
72 ÖStA HHStA Staatskanzlei Interiora Kt. 13–16. Chiffrenschlüssel.
73 Meister, *Die Geheimschrift*. David Alvarez, "The Papal Cipher Section in the Early Nineteenth Century," *Cryptologia* 17 (1993): 219–24.
74 Edmond Lerville, *Les Cahiers secrets de la cryptographie* (Paris: Rocher, 1972); L. Sacco, *Manuel de Cryptographie* (Paris: Payot, 1951).
75 Lerville, *Les Cahiers secrets*, 64–74; Commandant Bazeries, *Les Chiffres secrets dévoilés, étude historique sur les chiffres appuyée de documents inédits tirés des différents dépôts d'archives* (Paris, E. Fasquelle, 1901.).
76 Military History Archives of Budapest E. 1705/18.
77 Military History Archives of Budapest E. 1705/5, 6, 03, 16, 17.
78 MOL G 15 Caps. D. Fasc 80. fols. 38, 40, 46. MOL G 15 Caps. E. Fasc 109.
79 Beke and Barabás Samu *I. Rákóczi György*, 340–41.
80 HHStA, Ung Akt. Misc Fasc 422 Conv 1 fol. 72–79.
81 ELTE University Library, G. 4. Fol. Tom. V. 469–958.
82 HHStA Staatenabteilungen Türkei I. Kt. 112. Konv. 5. fol. 1–9 and fol. 17–28. I thank Dóra Kerekes for calling my attention to these sources.
83 HHStA Türkei I. Karton 28. Konv. 1. 1571. fol. 33–87, 44–47, 52–54, 65–66.
84 Benedek Láng, "People's Secrets: Towards a Social History of Early Modern Cryptography," *The Sixteenth Century Journal* 45, no. 2 (2014): 291–308.

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12 Afterword

The Critical Legacy of Medieval and Early Modern Cryptography before and after World War I

Katherine Ellison and Susan Kim

Twentieth-century innovations in ciphering and deciphering would not have been possible without the archival study of medieval and early modern cryptography and close attention to those archives by textual scholars and historians during and after World War I. We close this collection with the work of medievalist and early modern scholars like philologist John Matthews Manly, who was chair of the Department of English at the University of Chicago from 1898 to 1933 with exception of his leave from 1915 to 1919 to serve in the United States Military Intelligence Division (MID) during World War I.[1] This afterword is not a biography or a summary of Manly's accomplishments or the achievements of other scholars working from within the humanities: it is, rather, a cultural analysis of the implications of humanist scholarly methods, with particular attention to changing trends in critical reading, problems of interpretive authority, and emergent theories of collaborative authorship.

The juxtaposition of the records of Manly's scholarship with those of his service in military intelligence powerfully emphasizes not the difference but the overlap in the kinds of work he was doing. With Edith Rickert (also Manly's colleague in MID), Manly established the Chaucer Research Project at the University of Chicago in 1927, with the goal of not only producing an authoritative *Canterbury Tales*, but also, in doing so, of documenting all Chaucer manuscripts as well as all relevant sources of biographical and contextual information. Especially given the absence of a manuscript of the *Canterbury Tales* produced in Chaucer's hand, or even during his lifetime, the exhaustive collection, collation, and analysis of all of the early manuscripts and fragments of the *Tales*, evidenced in the 1940 publication of the eight-volume edition, display modes of intellectual training and networking also fundamental to the practice of cryptography and to work in intelligence. Manly and Rickert introduced a new rigorous methodology for textual study that, as Ralph Hanna III notes in *The Riverside Chaucer*, changed the landscape of Chaucerian and medieval scholarship: "With the appearance … of Manly and Rickert's monumental eight-volume, text, editing the poem could never proceed on the same footing as before."[2] This same

close scrutiny, informed by Manly and Rickert's knowledge of genre, political, philosophical, theological, social, and scientific contexts, and philology—the structures and historical development of languages and their relationships over time—would ground their work for the MID, as evidenced by Manly's notes and letters, as well as the recently discovered unpublished short articles on cryptography and his work for the MID, which Manly wrote in 1927 for *Collier's Magazine*.[3]

As Roy Vance Ramsey notes, the plan for the Chaucer Project was "simultaneously to test the genealogical method and to contribute to the understanding of Chaucer's text by publishing a complete record of all the textual variants in all of the manuscripts." Ramsey observes that Manly and Rickert "subjected them and the manuscripts themselves to by far the most systematic and thorough-going analysis ever attempted of the variants and study of the manuscripts of the *Canterbury Tales*—if not of any work."[4] Manly and Rickert would collect, reproduce (by means of "the relatively cheap process of photographic reproduction by the machine known as the photostat"), and collate all eighty-two manuscripts of the *Canterbury Tales* (eighty-three counting one print version attesting a lost manuscript original) in addition to the crucial informing contexts of the Chaucer life records.[5] The rigor of the project, as well as its anchoring in the material of the manuscripts, is clear even in the opening justification for the use of the Photostats

> in order to make possible not only careful collation of their readings but also such repeated examination of them as experience has shown to be necessary to avoid the errors of collation and the failures to note important details inevitable when a MS can be examined only occasionally.[6]

The very meticulousness of the collation process would drive the analysis of the relationships among the texts. Manly and Rickert explain in the second volume, "The purely mechanical procedure of collation will have resulted in groupings of MSS according to their readings without referent to whether the readings are correct or incorrect." "These are all, *prima facie*, merely variational groups," they continue, and "many of them are also in fact genetic groups, but which of them are genetic can be ascertained only upon further examination."[7]

Although a premise of the genealogical method is the existence of an original ancestor text ("O") which can be reconstructed through later variants, Manly and Rickert recognized that the "processes of the genealogical method (…) can result only in the establishment of the archetype where an archetype existed and in displaying the rival variants where copies existed separate from the main archetype."[8] Manly and Rickert, well into the collation, came to the conclusion that they would need to revise their basic premise to consider that Chaucer may have circulated

a number of tales before he had completed the sequence or the links between the tales during his lifetime, and then, after his death, links and tales were gathered in various combinations and used as exemplars for a second stage in the dissemination of the tales. Ramsey observes,

> There is even greater wonder in the fact that having invested so much of themselves in making this discovery, Manly and Rickert then had the drive and the fortitude to act upon it by completely starting over their new work of classification: because there had *never* been a single scribal original of the entire work ('O') but only *a scribal original of each link and each tale* (…), then they needed *to treat each link and each tale as a new problem of classification*.[9]

Given the enormous scope of the Chaucer project, as well as Manly's many other intellectual projects, and his work in intelligence, it is remarkable to encounter as well his investments in pedagogical materials, and from roughly the same period, in which he extends the methodologies evident in this work to the most fundamental kinds of instruction, from teaching young children to spell to guiding college students through paper-writing. For example, in volume two of *The Text of the Canterbury Tales*, Manly and Rickert provide very detailed description of the creation of the vital "collation cards" they used for the project. Just as an example, the opening description of the cards:

> The top margin is cut away so as to leave three projections: one at the left to receive the group letter and line number, as A 5; one at the right to receive a notation of the number of cards devoted to the collation of the particular line, as 5, and of the order of the card in the series, as 3 (thus "5 No.3" means there are five cards devoted to this line, of which this is No. 3); the third projection is a small tab capable of bearing the last figure of the line-number.[10]

The description continues with similar density for another full page before moving to the collation process through the cards:

> To begin, select a card with the right tab for the number of the first line to be collated. In the projection at the upper left hand corner write the group letter and line number (e.g. A 1, B 1191, G 554). First put in the proper spaces at the foot of the card the sigils of the MSS lacking tale or leaves (for lists to be often repeated a rubber stamp with moveable types is a time-saver) then stroke out with a slanting line the corresponding sigils in the printed list….[11]

Perhaps needless to say, the subsequent collation process is excruciatingly detailed, but as Manly and Rickert conclude in this section, the exacting

specification in the card collation system allows ultimately for the construction and demonstration of "a complete positive record of the readings and variational groupings of all the MSS" as well as creating significant checks for error.[12] The total count of collation cards for the project would reach over 60,000, with over half a million entries on those cards.[13] But although, surprisingly, Manly and Rickert do not come to this collation card system at the very start of the project, they do articulate, explicitly, the importance of a record of note-taking on manipulable cards to basic and foundational fluency in higher education. *The Writer's Index of Good Form and Good English*, which Manly and Rickert published together in 1923, for example, provides basic instruction for college students on how to use the library, how to learn to spell, how to format a paper, how to write a letter. The section on how to take notes for research emphasizes that

> many a scholar wastes much valuable time merely because he did not learn when he first began to do research work the all-important art of taking notes in the way to make them most useful with the least waste of time

and provides a nine-item list for how to write note cards, specifying the size of the cards, the spacing, and the importance of accuracy in quotation and systematic abbreviation and summary.[14] The organization of research materials, for Manly and Rickert, is the key to retrieving and subsequent analysis. They write, "The difference between the trained and the untrained mind lies not so much in the amount of information possessed by each as in the ability of the trained mind to get, without difficulty and without delay, information desired at any moment."[15]

The emphasis on a material system to support retrieval of data is also apparent in Manly's earlier work on pedagogical materials for very young students. The 1908 *Bailey-Manly Spelling Book*, a collaboration with Eliza R. Bailey, opens with a discussion of the necessity, given the fact that students "differ greatly in the kind of memory that serves them," for calling up "the aid of every form of memory that can be of service to us" in the teaching of spelling.[16] Manly and Bailey observe,

> Some spell from a memory of the sound of the letters. Others, when a word is spelled to them, cannot tell whether it is spelled correctly or not but guided by the motor-memories of their vocal organs can spell it aloud. Still others are never sure of a spelling until they see a word written and can test it by the mental image of its form; and some—as good spellers as the rest—must even resort to the muscular memory of the hand, and, letting the practiced hand go its accustomed way with a pencil or pen, will write correctly a word in regard to which none of the other modes of memory would have given them definite assurance.[17]

Here as Bailey and Manly address "modes of memory," they identify that the training of the mind can be multimodal: visual, aural, even muscular. While the material support for the retrieval of data for the college research paper or even the collation of *Canterbury Tales* manuscripts may be realized as a filing system for five-by-eight cards, other supports include the engagement of the lived body itself. In this sense, Bailey and Manly anticipate the approach to pedagogy and ciphering that will be explicit in Ricketts's *Ciphers for the Little Folks*, discussed in our introduction, an approach that grounded the teaching of ciphering in material practices as it instantiated a literacy that assumed, for the trained mind, a penetrable secrecy everywhere.

The contiguity of a culture of such literacy with that of explicit surveillance is evident in Manly's later treatment of the interception of private letters during his work for the MID. Manly opens the unpublished Collier's article on civilian correspondence by explaining, "One of the largest classes of cipher letters that MI-8 had to handle was furnished by the private correspondence of civilians," and he places the number of ciphered love-letters alone in the thousands.[18] He notes that while initial speculation was that the conditions of the war impelled the use of cipher, those conditions "rather interfered with than promoted the use of cipher for private correspondence, for there was practically no chance in the world that a letter that was plainly written in cipher could escape examination and reading."[19] Even as he cites examples of such enciphered private correspondence, Manly notes,

> It is one of the sordid incidents of a state of war that private correspondence of so intimate a nature that it seeks the cover supposed to be afforded by cipher should come to any other eyes than those of the persons for whom it was intended,

but, as he continues, "the public needs to be warned that in time of war, nothing is more certain than the fact that a cipher letter that falls into the hands of a censor is sure to be suspected and deciphered;" in fact, the only way to ensure privacy, he concludes, is to write "ordinary correspondence."[20] On another level, the contiguity of such literate culture with that of explicit surveillance is equally clear in the instructional materials that Manly and Rickert write for college students, who are advised to enter into the library like operatives:

> Begin by studying the arrangement of the different rooms in which books, periodicals, and catalogues are kept. Observe on which walls or on which tables works of general reverence are kept in the reading room. Observe the letters of the card catalogue that belong in each block of drawers. Observe on the cards themselves the letters that begin the call numbers of each class of books, indicating fiction, history, science, and so on. Remember that the more familiar you are with your tools, the better will they serve your purpose.[21]

Manly is careful to distinguish professional and amateur engagements with cryptography, however. Bridging his philological and cryptanalytic expertise, Manly provided his assessment of William Romaine Newbold's partial decryption of the Voynich manuscript.[22] Intrigued by Newbold's results and impressed by Newbold's high reputation as a scholar, Manly works step by step through Newbold's theory that Roger Bacon authored the Voynich manuscript and that the manuscript was actually the most important scientific document in early modern history. As a service to both early modern scholarship and to the discipline of cryptology, Manly reluctantly exposes Newbold's errors. He observes that because amateur cryptoanalysts did not fully understand what they were doing, they too quickly accepted Newbold's theory on the basis of Newbold's own stellar reputation as a scholar. "The method was understood by few," he notes, and "the results were in the highest degree sensational." But the implications of Newbold's research—that here "was one of the most important documents in the whole history of scientific thought"—were so exciting and attractive that scholars *wanted* it to be true.[23]

As in his work on Chaucer, his research advice to college students, and his advisement of children learning to spell, Manly is meticulous in his research and in the structure of his argument against Newbold's theory. In addition to tracing Newbold's many liberties in the Voynich, Manly looked to Newbold's readings of a range of archival texts to provide additional evidence for his friend's shaky methods. For example, Newbold had relied upon a famous gunpowder formula—a chemical recipe for making gunpowder—provided in a letter from Bacon that was printed in 1542. Manly discounts the alleged Bacon authorship of the letter as well as finds that its interpretation was based on a misreading of Greek letters in the original letter before the printing. How Newbold could decipher a formula based on a mistranslation is puzzling to Manly. Other documents that Newbold used for his solutions were also questionable; some were not written when Newbold claimed they were, some do not contain ciphers when he believed that they did, and in some Newbold contradicted himself by claiming, in different writings, that they used entirely different cipher systems. Manly notes that one could argue that these contradictions are a result of Newbold approaching the correct solutions, and that the earlier versions are merely the first steps in an ongoing process in which error is inevitable. However, he concludes, "no system of cipher can be valid or have the slightest claim to recognition if it permits such widely divergent readings as these."[24] Further, and in what is perhaps the final blow to Newbold's reputation, Manly points out a number of historical errors.

Newbold's case testifies to the dangers of deciphering to prove a preconceived theory and the ease with which an analyst with some training, but not expert knowledge, can manufacture material proof for a

self-fulfilling prophecy. The materiality of that evidence propelled Newbold forward and prohibited him from being able to stand outside his work and verify his methodology. "The chief reason why Professor Newbold clung so unshakenly to his method," Manley states, "was that he got messages containing statements which he supposed to be true and important and which he did not believe could have been supplied by his subconscious mental processes."[25] Still, Manly is puzzled by how such a highly trained, meticulous scholar could make such flagrant mistakes. Such cases only further supported the rigor of methods he had developed with Rickert and confirmed that good scholarship is not only a matter of content knowledge and memory but, more importantly, an organized approach to large volumes of information.

The example of the Newbold misreading of the Voynich manuscript also demonstrates a perhaps inevitable consequence of the rhetorical positioning of cryptography as the materialization of human intellect, as Ellison describes in her essay in this volume. Newbold's mind is projected onto the process of his deciphering. At first, when his work is accepted by the literary community (but not the cryptography community), the tedious work seems to reveal his eccentric genius. When Manly exposes him, a second, but no less problematic, kind of materialization appears: the delusional scholarly mind so obsessed with its work that it invents its own false conclusions. Manly exposes the lie, but he does also participate in the logic that the mind—and even the psychology—of a scholar can be revealed through its research methodology. He is alarmed by the implications of his findings. If left unchecked, Newbold would have altered an entire generation's understanding of early modern history. Manly even goes back to Newbold's first decryption ever, of Chapter X of *De Secretis Operibus Artis et Naturae, et de Nullitate Magiae* (*c.* 1267), which Newbold believed Roger Bacon had written and that depicts an Oxford student riot.[26] The text was allegedly written in cipher, which Newbold claims to have deciphered and then translated. Manly has the final, translated version and walks through a section with his reader. In this account of King Edward's activities on March 4, 1273, Newbold's decrypted, translated letter states that shortly after his coronation, Edward violated English law and ordered ecclesiastics, who inspired support from serfs with songs, to arrest knights studying at Oxford and then run them out of the city. The knights gave up the fight because it was the first of April, when they traditionally drink beer and wine.

Manly is astounded by this document and Newbold's handling of it, calling it "sheer nonsense." He points out several obvious inaccuracies, such as the use of "ecclesiastic" and "monk" interchangeably, the fact that no historical documents mention the significant violation of English law by Edward or the conflict, which would have been a major event with multiple records, the unlikelihood that serfs would be motivated

by "joyous carols and hymns," and the dubiousness of the statement that knights were studying at Oxford when they were interrupted by the ecclesiastics.[27] The only riots known to have occurred did not happen until 1274 and were between Northerners and the Irish, and no ecclesiastics or knights were involved. And besides, Manly notes, town chronicles indicate that there were historic rains and floods so severe during the month of March, 1273, that houses, walls, and trees were destroyed. The consequences of this kind of inaccurate scholarship, "the products of his own intense enthusiasm and his learned and ingenious subconsciousness," are, to Manly, far reaching. "That such a judgment must be passed upon the work of so learned and brilliant a scholar and so sincere and attractive a personality as Professor Newbold is almost tragic," he writes.[28]

To soften the blow of what might be one of the most condemning peer reviews of scholarship in academic history, Manly steps back to call Newbold's work "scholastic heroism" because he dared to take on the Voynich manuscript, the most complicated, baffling document in human history, and even dedicated all of the final years of his life to understanding it. This depiction, we note, is not merely a kind way to show respect after 46 pages of refutation. It is a continuance of the stereotype of deciphering as the work of a superior mind driven by obsession, even to the point of delusion. Even though Newbold is wrong in almost every step of his process, he is still "ingenious." In fact, Newbold's fault is that he was just *too* interested in his research question and hindered by his "extraordinary ingenuity." Newbold is a paragon of rigorous, exhaustive scholarship and a mind so powerful it gets away from itself, working eight full years nonstop on the project, interrupted only by his death. He is "the stuff of which heroes and martyrs are made."[29] If only, Manly notes, Newbold had not been ignorant of ciphers. That Newbold had access to the most knowledgeable cryptanalysts of his time, like Manly and William Friedman, through the social networks of his elite education, and that he ignored that expertise when it was freely offered, is not repeated in the conclusion.

Manly's campaign to reveal Newbold's misrecognition and misreading of the Voynich manuscript—the fact that he feels he must do this publicly and thoroughly, thus offering a cautionary tale of the academic mind so obsessed with its subject that it falsifies history—is relevant to this collection not only because it is about studying early modern ciphers but also because it emphasizes how the history of ciphering foregrounds interpretive authority as one of the central issues in the history of human communication. Ciphers, and interest in ciphering, appear and multiply in times of interpretive crisis, particularly when local community members find that they cannot understand or trust one another. Periods of political faction, civil or cold war, revolution, internal family feuds, dissolving or shifting friendships and alliances, cultural clashes

as indigenous and migrant populations adjust to the hybridities of colonialism, theological schisms—ciphers emerge from these fissures and fusions as counter texts but also as manifestations of the attempt itself to lay claim to interpretive authority.

William H. Epstein's "Counter-Intelligence: Cold War Criticism and Eighteenth-Century Studies," an essay published in *ELH* in 1990, took on this historical concurrence of interpretive crisis and the popularity of ciphering in what is a foundational article in early modern and eighteenth-century study. Epstein reported what many historians of the late twentieth century apparently did not know: that literary historians were using the methodologies of traditional historical study and New Critical close reading to provide counter-intelligence during the Cold War. It was a "reciprocal interpenetration," Epstein writes.[30] Theoretically, Epstein's essay is a response to Frank H. Ellis's "Gray's Elegy: The Biographical Problem in Literary Criticism" (1951).[31] Ellis had confronted the problem of archival research after massive collection efforts allowed scholars unprecedented access to primary documents, and his guiding question was whether or not these archives, in combination with the close reading of authors' productions, could provide the literary scholar with new ways to understand the author's biographical life and culture. In a sense, Ellis's essay was about how historians and literary critics should adjust their methods after the massive collection and organizational efforts of scholars like Manly and Rickert, though the Chaucer project and its editors are not referenced. He uses Thomas Gray as a case study to argue that close reading of the primary sources does not, in fact, reveal credible biographical information. Epstein critiques the liberties that Ellis's hybrid historicist/New Critical methodology allow him to take with Gray's life and work, seeing in Ellis's own reading practices a contradiction of his argument. Ellis rewrites Gray's identity and career, piecing together a new narrative of Gray from a range of historical artifacts including letters, poems, and state trials, performing close readings of these artifacts as "anonymous, impersonal, ahistorical" documents.[32] This decision to use two "seemingly irreconcilable" methodologies together, Epstein argues, is "presumptive" and downright "slippery."[33]

What is more, Ellis, like Manly and Rickert, was not only a literary scholar. He also served in intelligence in the U.S. Army during World War II and then worked for the Central Intelligence Agency (CIA) until 1954. "Thus Ellis moved, literally and figuratively, through the interstices of several elaborate networks of deceptive practices, a not uncommon situation for many American and British university professors during and after the war," Epstein observes. We note, here, that Epstein assumes this professional activity is "deceptive" and, in the next sentence, is "secretive and suppressive centrism;" for Epstein, there is something fundamentally disturbing about intelligence work—it is an "infiltration," an "interpenetration," a "tangled web," a "tactic of resuming authority."[34] Epstein's

speculation, in which he notes the relationships that U.S. American and British scholars and intelligence analysts built around their mutual double agencies, is that

> as members of an overlapping network of intelligence communities (MI5, CIA, Oxford, Yale, historical scholarship, literary criticism, etc.), they participated in another special relationship—an affiliative network of cultural consanguinity allusively interconnected in a "mosaic of citations"—through which, by the sheer force of banality and coincidence, they were bound to meet.[35]

In other words, Epstein argues, the methodologies of Cold War counterintelligence work and New Critical and historicist literary study became kinship communities that represented the same points of view and referenced and reinforced one another in a kind of centrist cycle. This small circle was linked only by their happenstance participation in both intelligence and the humanities, not by any academic logic grounded in historical study.

By contextualizing ciphering within its changing cultural landscapes, humanists and scholars of the arts and sciences engage in a type of criticism that seems to assume an artifact can reveal disguised truths upon close scrutiny by disciplinary professionals. Such a stance is, as Epstein notes, controversial. Epstein outlines the stakes of cultural criticism of this nature, beginning with the metaphor of the "gesture" that might remind readers of this volume of Michael C. Clody's Chapter 8. Clody points out that the craft of gesture to communicate private messages began, at least instructionally, with the limitation of monolingualism—John Wilkins and John Bulwer assumed that signs made by the hands or the body must translate as alphabetic, English words, therefore missing an opportunity to "honor the unique nature of sign."[36] This shortcoming postponed the potential of gesture for communication by deaf communities. Epstein points to similar limitations in the scholarly community of the 1980s and 1990s, during the later period of the Cold War, when literary critics and historians began to theorize the "gesture" toward an artifact "as a way of sanctioning critical activity under the cover of some other activity."[37] For Epstein, gesturing is the quintessential academic movement, the way in which scholars remove themselves from the discussion by merely pointing to possible connections between a subject and its contexts, genres, authors, or readers, signaling to students that the pedagogy is in the presentation of those connections, not the conclusions. Such gesturing increases the odds of misrecognition and misinterpretation of artifacts, he finds, and it is also forcefully directional even as it pretends to merely open up a connection. The scholarly gesture, Epstein continues,

> attempts to transfer authority (or at least the temporary site of authority) from a human body (the critic's) moving through and

> contextualized within cultural space-time, to a reified sign (the author, the text, etc.) seemingly stabilized within an autonomous, disciplinary matrix; it is also a way of misrecognizing the participation of individual critics in the community of professional practice.[38]

There are two problems with Epstein's characterization of the gesture if one keeps in mind the actual practice of gesturing in the history of ciphering, a comparison Epstein invites by assuming that the academic gesture is at play in counter-intelligence. One problem is that in intelligence, the material sign that is deictically motioned toward with the gesture is never assumed to be either stable or autonomous. It is assumed that the sign is dependent upon other signs, and that it must operate within a grammar, and the sign and gesture both must be flexible and multivalent—they must be able to change position, meaning, and condition depending upon the rules set forth in the interactive contract between sender and receiver. The second problem, then, is that the individuals in this exchange do not pretend *not* to participate in the meaning-making, as some literary critics might have before the 1990s, at least insofar as each is aware of the other and their participation does or does not need to be secret beyond their relationship.

It is true, though, that those who study language and narrative, as well as those who study intelligence, similarly fret "characteristically over language, over the control of the emotive import of word."[39] The effect of Cold War paranoia and surveillance on literary study, according to Epstein, is that it perpetuated a methodology in which authors were seen as operating undercover as poetic speakers and narrators. Literary critics performed covert surveillance on texts, asserting authority to unearth hidden secrets. They dealt in ambiguity. The effect of literary study on the Cold War, which Epstein persuasively outlines as he lists the many members of the Yale English department who became high-ranking agents and analysts in the Office of Strategic Services (OSS), Research and Analysis (R&A), and Counter-Intelligence (X-2) offices during World War II, was predominantly organizational. Using the same methods that they had adopted to edit the massive Yale edition of Horace Walpole's correspondence, for example, former literature professors and students created a massive card catalog database of primary and secondary sources, "specialized knowledge and strategic information"[40] from around the world. Here we return then to Manly's insistence on the precision of note-taking on cards for college students, as well as the collection of 60,000 collation cards for the Manly-Rickert *Canterbury Tales*. The CID collection, not surprisingly given the training of many of its personnel, employed a fundamental tool for data collection, collation, and analysis, as well as the training of the mind, that emerged in the study of medieval and early modern texts. In a reciprocal turn, the CID organization of knowledge of the world would prompt

changes in academic disciplines, among them the founding of interdisciplinary global studies.

The recognition of this "strange, twilight world of multiple deceptions in which real and notional double-and triple-agents pass and receive fragmentary pieces of true and false information" as it was lived by figures like James J. Angleton, Epstein notes, created a "paranoid analytical mode."[41] It was also inevitable that the political situations and alliances of the Yale scholars/intelligence analysts would permeate their scholarly work, which Epstein traces in James Steele's criticism on Gray's poetry. "Denying one's own voice and one's own situatedness, seeking silence in order to resist contextualizing both critical activity and the object of criticism," Epstein concludes, "is classic New Critical professional practice, into which many Cold-War critics were directly or indirectly indoctrinated."[42] Again, Epstein's essay was groundbreaking in its exposure of these influences across institutions, disciplines, and methodologies. Yet, one must also be careful not to confuse the practices of intelligence and counter-intelligence, bureaucratically and even organizationally, with the specific practices of ciphering and deciphering. It is also true that the "paranoid analytical mode" that Epstein locates during the Cold War was already in place during Manly's service for World War I as well as much earlier, in the very medieval and early modern texts that he studied to learn more about the applicable methods of cryptography in its foundational history.

Both Manly and Epstein were writing during periods of faction and fissure, and ciphering was centralized in discussions of literacy and critical interpretation at other historical junctures as well. Two in particular stand out in the chronology of cryptography, and both—like Epstein and Manly's examples—look back to the broad early modern period, in which we include the eighteenth century, for answers. Before Manly, from the 1850s through the 1880s, ciphering seemed to provide literary and historical criticism with the key to a secret treasure for which it had been searching, and Francis Bacon's alleged authorship of Shakespeare's plays and verse was the pivot of that secrecy. After Manly, in the 1950s, Fabyan's pursuit of that theory again foregrounded the problematic role of cryptography in humanistic inquiry, and vice versa, setting up the suspicious relationship that Epstein clearly critiques forty years later.

Proving the Bacon hypothesis was the life obsession of Fabyan, whose laboratory was one of the first homes of U.S. intelligence. In 1915, William F. Friedman moved to Fabyan's laboratory to work on the Bacon-Shakespeare project with Elizabeth Smith, who would later become his wife. Fabyan was influenced by earlier scholars such as William H. Smith and Delia Bacon (no apparent relation to Francis Bacon). In 1857, both Smith and Delia Bacon published studies arguing for Francis Bacon's authorship of Shakespeare's works. As a literary scholar, Delia

Bacon was praised by Nathaniel Hawthorne, Harriet Beecher Stowe, Ralph Waldo Emerson and other contemporary authors and had even defeated Edgar Allan Poe in a short story contest. Hawthorne himself wrote the preface to Delia Bacon's *The Philosophy of the Plays of Shakspere Unfolded* (1857), explaining her methodology.[43] Hawthorne accused Smith of publishing Delia Bacon's theory as his own, though Smith would publish letter correspondence between himself and Hawthorne as evidence that Hawthorne withdrew that accusation and apologized. Here we consider Delia Bacon's scholarship more closely than Smith's because of the breadth and depth of her mission to prove Francis Bacon's ciphered, collaborative project under the identity of Shakespeare.

Delia Bacon believes that she is developing a "different species of criticism" in 1857 (566). She rebels against the acceptance of historical knowledge on authority of either experts or archives, urging readers to be suspicious when they consult with the original documents of a period for "direct contemporary testimony" because those documents may in fact have been designed to mislead readers and hide truths that contemporary reading practices failed to notice because the truths were too dangerous (567). Documents of the Elizabethan period in particular, she argues, were heavily censored, and she claims that Francis Bacon and several of his contemporaries wanted to forward a revolutionary new philosophy that was so bold that it had to be protected in layers of veiled meanings across separate pens and artistic and scientific works. She calls that new philosophy the "Elizabethan Innovation" and the "Scientific Human Culture" (529). Delia Bacon is not entirely clear about what Francis Bacon et al.'s innovation in scientific culture was beyond a plan

> to create a better leadership of men,—to form a new order and union of men,—a new nobility of men, acquainted with the doctrine of their own nature, and in league for its advancement, to seize *the 'thoughts'* of those whose law is the law of the larger activity, and *'inform them* with nobleness.'[44]

"That was the plan," she writes, and it had to be hidden from those of their own time so that readers of a much later time, like her own, could uncover it and then put the plan into action.

To prove that Francis Bacon and his colleagues ciphered their blueprint for this plan to unionize and promote some kind of doctrine of nature to be completed by the puzzlers of a later generation, Delia Bacon collates lines from Shakespeare's poetry and plays, juxtaposing them with one another, and with her own brief commentary interjected. For example, in a chapter on "New Constructions—The Initiative" she cites from Sonnets 55, 64, and then 65 quickly in a row. Delia Bacon's analysis is in the brackets [ ] within and between sonnets and then at the end

without brackets, and we quote it in full so that the reader can see the interplay between the lyrics and her interpretation of them:

> 'Now with the drops of this most balmy time
> My love looks fresh, and death to me subscribes;
> Since, spite of him, I'll live in this poor rhyme,
> While he insults o'er dull and speechless tribes;
> And *though* in this shall find thy monument,
> When *tyrants' crests and tombs of brass* are spent.'
> 'Not marble, nor the gilded monuments [*Elizabethan AGE*.]
> Of *Princes* shall outlive this *power*-ful rhyme.'
> [This is our unconscious Poet, who does not know that his poems are worth printing, or that they are going to get printed—who does not know or care whether they are or not.]
> 'But you shall shine more bright in these contents,
> Than unswept stone besmear'd with sluttish time.
> When wasteful war *shall statues* overturn [iconoclasm],
> And *broils* [civil war] root out the work of masonry,
> Nor Mars his sword, nor war's quick fire shall burn
> The *living record of your memory*.'
> [What is it, then, that this prophet is relying on? It is a manuscript? Is it the recent invention of goose-quills which he is celebrating here with so much lyrical pomp, in so many, many lyrics? Here, for instance: —]
> 'His *beauty* shall in *these black lines* be seen,
> And *they* shall live, and he in them still green'
> And here—
> 'O, where, slack!
> Shall *time's best jewel* from *time's chest* lie hid?
> Or what *strong hand* can hold his swift foot back?
> Or *who* his spoil of beauty can forbid?
> O none, unless *this* miracle [this *miracle*] have might,
> That in *black ink*—'
> Is this printer's ink? Or is it the ink of the prompter's book? or the fading ink of those loose papers, so soon to be 'yellowed with age,' scattered about no one knew where, that some busy-body, who had nothing else to do, might perhaps take it into his head to save?
> 'O *none*, unless this miracle'—THIS MIRACLE, the rejoicing scholar and man of letters, who was not for an age, but for all time, cries – defying tyranny, laughing at princes' edicts, reaching into his own great assured futurity across the gulfs of civil war, planting his feet upon that sure ground, and singing songs of triumph over the spent tombs of brass and tyrants' crests; like that oratory who was to make an oration *in public*, and found himself a little straitened in *time* to fit his words to his mouth *as he had*

> *a mind to do*, when *Eros*, one of his *slaves*, brought him word that the audience was deferred till the next day; at which he was so *ravished with joy*, that he *enfranchised him*. '*This miracle*.' He knows what miracles are, for he has told us; but none other knew *what* miracle this was that he is celebrating here with all this wealth of symphonies.[45]

Delia Bacon takes great liberties as she moves from one sonnet to the next, piecing together phrases to arrive at the exclamatory argument that "THIS MIRACLE" refers to Francis Bacon's ciphering of his public message so that only an audience of the future can understand him. Manly and Rickert's organizational methodology is, in a sense, a reaction against this kind of reading across a large number of documents. What is appealing about Delia Bacon's interpretive style, though, is her invitation to the reader to work alongside her to solve the puzzle of Shakespeare's pseudo-authorship. Such a posture is rhetorically effective if not finally persuasive: she knows that her stance is highly controversial, so she approaches her argument as a guided tour of literary sources, planting seeds of suspicion as she moves through one Shakespeare writing after another. She does not write with the same literary authority as, for example, her contemporary Edgar Allan Poe earlier in his 1846 *Philosophy of Composition*, who proclaims his method and tells the reader with certainty how and how not to read and compose. Instead, she frequently asks questions of the reader and speculates in real time, raising doubts. Her method actually resembles the ratiocination of Poe's own C. Auguste Dupin; the use of intuition and exaggerated logic—a kind of hyperlogic in which the subject of study is decontextualized to the point of abstraction and yet, as Epstein argues about Cold War criticism, is still projected from its own time period—to make grand assertions based on small details and largely coincidental parallels. This ratiocination, we find, is an attempt to imitate and even activate the methodologies of ciphering and deciphering in and through literary analysis, but it becomes a parody of real practice. Because Delia Bacon is not working with actual ciphers, she cannot reenact the full problem solving process to reach a plaintext conclusion. She can only *suggest* or, as in the terms Epstein provides, *gesture toward* the connections without proving them. Yet, she is aware that this suggestion is not typical of the critical tradition. She draws a parallel between her method and the scientific project she thought Francis Bacon was revolutionizing: she believed that he and his contemporaries were encouraging a "new intellectual habit" "put down *as* anticipations, not *interpretations*."[46]

Delia Bacon's work was just one of several during the mid to late nineteenth century that expressed frustration with traditional modes of reading in literary study and attempted to steer interpretation in new directions. Catharine F. Ashmead Windle's *Address to the New*

Shakespeare Society of London on Discovery of Lord Verulam's Undoubted Authorship of the "Shakespeare" Works (1881) and Ignatius Donnelly's *The Great Cryptogram* (1888) would also use the theory of Francis Bacon's authorship of Shakespeare to suggest new reading practices using the methodologies of ciphering and deciphering, but like Delia Bacon, they lacked the knowledge of cryptography history and practice to do so persuasively for contemporary and future scholarly audiences. More convincing, methodologically, was perhaps *The Cipher Found: Lord Bacon's Work Located in One of the Plays* (1888), in which Charles W. Augustus used archival documents to acknowledge that Shakespeare did exist, that he did write most of the plays attributed to him, and that only in one scene of *The Taming of the Shrew* is there sufficient evidence that a cipher is embedded.[47] He traced previous versions of *Taming* to argue that Shakespeare's is a collation and revision of several writings and productions, and he pointed to one conversation in Act III, Scene I in which Bianca, Lucentio, in disguise as Cambio, and Hortensio, in disguise as Litio, engage in a ciphered exchange. While Bianca and Lucentio playfully flirt, Hortensio plays an instrument, first out of tune.

Lucentio

Here, madam:
"Hic ibat Simois; hic est Sigeia tellus;
Hic steterat Priami regia celsa senis."

Bianca

Conster them.

Lucentio

"Hic ibat," as I told you before, "Simois," I am
Lucentio, "hic est," son unto Vincentio of Pisa,
"Sigeia tellus," disguised thus to get your love;
"Hic steterat," and that Lucentio that comes
a-wooing, "Priami," is my main Tranio, "regia,"
bearing my port, "celsa senis," that we might
beguile the old pantaloon.

Hortensio

Madam, my instrument's in tune.

Bianca

Let's hear. O fie! the treble jars.

Lucentio

Spit in the hole, man, and tune again.

Bianca

Now let me see if I can conster it: "Hic ibat
Simois," I know you not, "hic est Sigeia tellus,"
I trust you not; "Hic steterat Priami," take heed
he hear us not, "regia," presume not, "celsa senis,"
despair not.

(*Taming* 3.1.27–45)

Augustus is correct that Bianca and Lucentio are here engaging in a secret exchange, though it is not a cipher. Lucentio quotes from Ovid's *Heroides* in what has been largely read as a humorous decontextualization, so that Lucentio is *pretending* to use cipher, satirizing the practice and its popularity, and Bianca is playing along. Augustus is more interested, though, in what comes next, when Hortensio has finished tuning his instrument and tells Lucentio that he has made a mistake, and he asks Lucentio to step aside so that he can teach Bianca (with obvious sexual connotations) how to use his "instrument," passing her a letter with an apparent cipher key:

Hortensio

Madam, before you touch the instrument,
To learn the order of my fingering,
I must begin with rudiments of art;
To teach you gamut in a briefer sort,
More pleasant, pithy and effectual,
Than hath been taught by any of my trade:
And there it is in writing, fairly drawn.

Bianca

Why, I am past my gamut long ago.

Hortensio

Yet read the gamut of Hortensio

Bianca [Reads.]

"Gamut' I am, the ground of all accord,
'A re,' to Plead Hortensio's passion;
'B mi,' Bianca, take him for thy lord,
'C fa ut,' that loves with all affection:

> 'D sol re,' one clef, two notes that I:
> 'E la mi,' show pity, or I die."
> Call you this gamut? tut, I like it not:
> Old fashions please me best; I am not so nice,
> To change true rules for odd inventions.
>
> (*Taming* 3.1.64–81)

What Augustus does with this scene is, like Newbold's reading of the Voynich and Ellis's reading of Gray, an example of critical acrobatics. Believing this scene to be a musical cipher, Augustus numbers the syllables in each of the nine lines of the message Bianca reads, but he excludes the word "gamut" because it rhythmically does not fit his proposed system. Augustus notices that every ninth syllable (which he determines by sound, not spelling, since he notes that English was not standardized during the early seventeenth century) begins with a letter that, when unscrambled, spells "Lord Bacon," which it in fact does not (the 45th syllable in Augustus's chart is the letter "I," for example). If one overlooks this error, the next step in the decipherment is to then reorganize Bianca's letter into six lines so that each one has nine syllables (with no explanation beyond his assumption that "nine, as a basic number, is too well known to require any particular comment. It is the key of the numbers.")[48] Then, Augustus reverses the order of the words of the letter so that they read backward. Finally, he explains:

> let us group these syllables into nines, and await the result. In the first place let us take the 9th syllable of the gamut, and the syllable next to it answering to the 45th syllable in the reversed gamut; then let us take the 18th syllable of the gamut, and the syllable next to it, answering to the 36th syllable of the reversed gamut; then let us take the 27th syllable of the gamut, and the syllable next to it, answering also to the 27th syllable of the reversed gamut, and continue so far as the gamut will permit.[49]

The result of all of this skipping around in the syllables of Bianca's letter, and even some diagonal reading across those syllables, is that Augustus is able to suddenly see the words "Lord Bacon, remedie." Reaching his grand conclusion, Augustus says, "In other words this is the way we cure Bacon. We trust the reader will scrutinize the cipher carefully to see how perfect it is in every respect."[50] And besides, he notes, "Bianca" is just a "metathesis" of the word "Bacon."

In 1957, the Friedmans published *The Shakespearian Ciphers Examined*, reissued in 2011 with Cambridge University Press, discounting theories like Augustus's and the work of Ashmead Windle, Donnelly, and Elizabeth Wells Gallup and, in the process, providing a much-needed distinction between ciphering, symbolism, and punning.[51] They countered a literary tradition

they believed had been emerging over the past decades in which scholars were reading only to solve puzzles. They pointed to Ashmead Windle and Donnelly's works in particular as examples of the misguided interpretation they felt was taking over literary criticism: "all over the world dogged and ingenious heads now pored over the texts themselves—not for their beauty or their significance, but for the hidden simple acrostic, acrotelestic, numerologic or other concealed messages."[52] The Friedmans appear to think this a recent critical shift, just as Epstein believed of the Cold War "paranoid analytic mode," though given Delia Bacon's work it was clearly a century in progress and, with Manly's work as evidence, often contested.

What is perhaps most useful about Delia Bacon's work, and about Augustus's analysis of changes in Shakespeare's plays over time, is their attention to collaborative authorship and Delia Bacon's recognition of what she calls the "secret of inclusiveness."[53] One can critique their use of sources and failure to cite what anything is from or where to find it, their interpretive liberties with the language, their lack of knowledge of the historical contexts of their material, and their misunderstanding about what ciphers actually were or are. Yet, they pinpoint a campaign that did seem to be in progress during the seventeenth century, though not secretly or enacted across ciphers in plays and poetry. Delia Bacon does not mention John Wilkins or the universal language writers of the period, but they, in conversation with Francis Bacon and others, did, through their scientific writings, imagine a type of collective intelligence that would make global knowledge sharing more effective and efficient. Cryptography, as a discipline, was promoted partly for this purpose because it represented a contractual, teachable language that promoted collaborative problem solving. Delia Bacon's ciphering project also highlights a moment in the history of literacy during which cryptography appeared to provide a way for humans to connect and communicate meaningfully during times of isolation and loneliness, and sometimes in alliance against a common enemy, and she recognized in the early modern context a similar yearning for connection. Wilkins openly discussed this solitude, and like cryptographers before him, worked back in time to the polyglot curse of Adam and Eve to locate the roots of this linguistic isolationism. As the medieval materials discussed in this volume also indicate, ciphers mediated during periods when cultures and technologies, including both the techne of writing and literate culture itself, coincided and shared overlapping, contested and ambiguous borders.

As scholars, Newbold, Delia Bacon, and Augustus seem to have wanted an early modern archive that could speak to them alone: Delia Bacon writes that

> the solution was reserved for one who would recognize, at last, in the disguise of the great impersonal teacher, the disguise of the new learning. It waited for the reader who would observe, at last, those

> thick-strewn scientific clues, those thick-crowding enigmas, those perpetual beckonings from the 'theatre' into the judicial palace of the mind.[54]

This idea that the past plants secrets for one scholar from the future, a "great impersonal teacher," to uncover, indicates a desire for connection that she, Augustus, and Newbold find answered in Francis Bacon's philosophy and in the idea that Roger Bacon had authored the Voynich manuscript. Hawthorne would emphasize this desire in his preface to Delia Bacon's *Philosophy*. Hawthorne takes time to stress that Delia Bacon should be accepted by both British and U.S. scholarly audiences because she is one of them; she has lived amongst them, studied their documents, and is familiar with their cultures. At first it seems odd that Hawthorne takes such pains to authorize her belonging, her understanding of the scholarly communities and cultures of both the U.S. and England, in an appeal for her acceptance by those academic audiences, but within the context of her own emphasis on a network of minds connected across time, space, and culture, Hawthorne seems to understand her rhetoric as tied to a larger question about identity and cultural inclusiveness.

Hawthorne works to position Delia Bacon within scholarly communities, in part because these communities authorize scholarship but also to play out the social networking through which "great minds" are themselves created. In the absence of present-day rapid transfer of text, for example, through electronic exchange, researchers like Delia Bacon, Augustus, Newbold, Manly, the Friedmans, Ellis, and Epstein maintained active networks for resource sharing with other scholars in the field, working collaboratively across borders (even as Epstein was suspicious of those connections, he also shared them). Records of Manly's correspondence with other scholars working on the Voynich manuscript, for example, detail not only Manly's sometimes provocative methods for testing his colleague's hypotheses, but also the role of social networking in the dissemination of information about as well as the analysis of these texts. Manly cites several instances of international and cross-disciplinary information exchange that made both his and Newbold's work possible. "From time to time we heard reports of new revelations," Manly writes, "a medical treatment for Pope Clement IV; a recipe for refining copper ores, that had been verified by chemists of the University of Pennsylvania." Newbold shared his work widely, and

> he had from the very beginning of his investigations discussed every phase of his work and every new discovery with a sympathetic and intelligent friend. This friend, Professor Roland G. Kent, in 1928, with devoted fidelity, published a volume which sets forth Professor Newbold's work clearly, skilfully, and impressively.[55]

Newbold had sent Manly his alphabets in 1921, and both Manly and Newbold had also been in frequent correspondence with scholars and cryptanalysts like William F. Friedman.[56] Manly reveals, too, that he had even shared his discoveries of Newbold's errors *with* Newbold early in his process. Manly includes Newbold's response to his corrections in 1922 in his essay. Newbold replied:

> I am deeply indebted to you for the corrections in the readings of the MS which you send me. Setting aside the c's and t's, which are virtually indistinguishable, I think you are right in most of them; there are only a few about which I am uncertain. The most important is "tale signum sequens," which is so obvious I ought to have seen it myself. If the correction needed confirmation the translation would supply it: "scribi a Randa sui monte." '[instead of (insanus!) illustria perscribi].3' P. S. After finishing this letter, I tried out your corrections in the passage I. 774–800. As you will see, the resulting letters readily recompose into a much better text, in which the jejune sancto and the inaccurate de Deo disappear: "unica causa. In coelo anima, lux generata recipit cupam," etc.
>
> [instead of "unico sancto. Accipit animus de Deo cupam"].[57]

Newbold is gracious in his response but also seems to not understand the implications of the errors that Manly has informed him of. Clearly determined to push on with his method despite its proven flaws, he integrates Manly's suggestions seamlessly into his deciphering without at all rethinking the approach. Manly follows the insertion of this letter with this frustrating reality: "But the total number of letters either certainly wrong or subject to grave suspicion is really very large—over 400 out of a total of 1955, or more than 20 percent."[58] Manly also consulted other expert cryptanalysts to help him verify Newbold's mistakes. In Newbold's inaccurate analysis of *Tractatus Trium Verborum*, a text he used to identify Baconian cipher groups, Manly finds that

> The cipher is simple and easy, and no two competent cryptographers would differ in the reading of it. Mr Robert Steele (see *Nature*, October 13, 1928, p. 564) and Dr Dorothea Singer (Cat. … Alch. MSS, i, 170) independently read it alike and as I do (and did in a letter to Professor Newbold in 1922).[59]

Manly was not only integrated into a broad network of scholars and experts from whom he could borrow books and with whom he could consult and collaborate; he also collaborated intimately and over a very long period in his research, most notably with Edith Rickert. As J. R. Hulbert wrote of Manly in the *Modern Philology* article after his death (Manly had for many years served as general editor for the journal),

> Not only was it necessary for him to have someone to do much of the work which he could not find time to do himself; it was necessary to have a scholar, acquainted with the phenomena, with whom he could 'thresh out' the problems.[60]

The *Canterbury Tales* edition, in fact, would come to be called "Manly-Rickert," in recognition of the joint work of both, despite Manly's greater professional prominence during his lifetime. The scholarship was highly relational: it was produced in a broad network of connection as well as in intimate collaboration. As Epstein has demonstrated, the extent to which networks of connection were often contiguous, even overlapping across literary, university and intelligence communities makes clear the fiction of claims to a-historical, or de-contextualized, impersonal "truth" in some approaches to literary studies. At the same time, the explicit engagement with ciphers and secret writing in the context of other kinds of literary endeavors by scholars of the medieval and early modern period, including scholars, like Manly and Rickert, who also worked in intelligence, also details powerful efforts to approach and to defend to the utmost the construction of accurate, thorough, and complete historical, contextualized knowledge, including through the sometimes highly personal professional networks they built and maintained. In this collection, we begin with the insight that engagement with ciphering is also engagement with "ways in which human languages can and cannot express experience."[61] We propose, however, that in the exploration of this engagement, in the formation and sustaining of networks of collaboration for and through our research on secrecy and concealment, we also work against "paranoid analytical modes" as we both interrogate and share what we know.

Notes

1 Manly's papers are now accessible through the University of Chicago Library. The papers are described at: www.lib.uchicago.edu/e/scrc/findingaids/view.php?eadid=ICU.SPCL.MANLY.
2 Ralph Hanna III, "Textual Notes: The Canterbury Tales," in *The Riverside Chaucer*, ed. Larry Benson, 3rd ed. (Boston, MA: Houghton Mifflin, 1987), 1119.
3 The articles are printed and discussed in John F. Dooley, *Codes, Ciphers and Spies: Tales of Military Intelligence in World War I* (New York: Copernicus Books, 2016). doi:10.1007/978-3-319-29415-5.
4 Roy Vance Ramsey, *The Manly-Rickert Text of the Canterbury Tales* (Lewiston and New York: The Edwin Mellon Press, 1994): 70–71.
5 John Matthews Manly and Edith Rickert, *The Text of the* Canterbury Tales *Studied on the Basis of all Known Manuscripts*, volume 1 (Chicago, IL: University of Chicago Press, 1940), 1.
6 Ibid., 1.
7 Ibid., vol. 2, 20.

8 Ibid., vol. 2, 40.
9 Ramsey, *Manly-Rickert*, 160.
10 Ibid., 3–4.
11 Ibid., 5–9.
12 Ibid., 9.
13 Ramsey, *Manly-Rickert*, 83.
14 John Matthews Manly and Edith Rickert, *The Writer's Index of Good Form and Good English* (New York: Henry Holt and Company, 1923), 29, 29–32.
15 Ibid., 3.
16 Eliza R. Bailey and John M. Manly, *The Bailey-Manly Spelling Book*, vol. 1 (Boston, MA: Houghton Mifflin, 1908): iv.
17 Ibid., iv.
18 Article XI, in Dooley, *Codes, Ciphers, and Spies*, 139, 140.
19 Ibid., 139.
20 Ibid., 142.
21 Manly and Rickert, *Writer's Index*, 20.
22 John Matthews Manly, "Roger Bacon and the Voynich MS," *Speculum* 6, no. 3 (1931): 345–391.
23 Ibid., 345–346.
24 Ibid., 359.
25 Ibid., 374.
26 *Epistola fratris Rogerii Baconis de Secretis Operibus Artis et Naturae, et de Nullitate Magiae*, in *Fr. Rogeri BaconOpera quaedam hactenus inedita*, ed. John S. Brewer (London: Longman, Green, Longman & Roberts, 1859).
27 Manly, "Roger Bacon," 375.
28 Ibid., 390.
29 Ibid., 391.
30 William H. Epstein, "Counter-Intelligence: Cold-War Criticism and Eighteenth-Century Studies," *ELH* 57, no. 1 (1990): 68. See also Robin W. Winks, *Cloak & Gown: Scholars in the Secret War, 1939–1961* (New York: William Morrow, 1987) and Michael Holzman, *James Jesus Angleton, the CIA, and the Craft of Counterintelligence* (Boston: University of Massachusetts Press, 2008).
31 Frank H. Ellis, "Gray's Elegy: The Biographical Problem in Literary Criticism," *PMLA* 66 (1951): 971–1008.
32 Epstein, "Counter-Intelligence," 69. Epstein here references J.C. Masterman, *The Double-Cross System in the War of 1939 to 1945* (New Haven, CT and London: Yale University Press, 1972).
33 Ibid., 70.
34 Ibid., 73.
35 Ibid., 73–74.
36 Cite Clody pg. #.
37 Epstein, "Counter-Intelligence," 64.
38 Ibid., 65.
39 Ibid., 76.
40 Ibid., 82.
41 Ibid., 85.
42 Ibid., 89.
43 Delia Bacon, *The Philosophy of the Plays of Shakspere Unfolded* (London: Groombridge and Sons, 1857). William Henry Smith, *Bacon and Shakespeare. An Inquiry Touching Players, Playhouses, and Play-Writers in the Days of Elizabeth* (London: John Russell Smith, 1857).

44 Bacon, *Philosophy*, 527.
45 Ibid., 525–526.
46 Ibid., 523.
47 Charles W. Augustus, *The Cipher Found: Lord Bacon's Work Located in One of the Plays* (Chicago, IL: Emil Simon & Co., Printers, 1888).
48 Augustus, *Cipher*, 56.
49 Ibid., 58.
50 Ibid., 58.
51 William F. and Elizabeth S. Friedman, *The Shakespearean Ciphers Examined: An Analysis of Cryptographic Systems Used as Evidence That Some Author Other Than William Shakespeare Wrote the Plays Commonly Attributed to Him*, rev. ed. (1957; repr., Cambridge: Cambridge University Press, 2011), 3.
52 Ibid., 5; Catharine F. Ashmead Windle, *Address to the New Shakespeare Society of London on Discovery of Lord Verulam's Undoubted Authorship of the "Shakespeare" Works* (San Francisco, CA: Winterburn & Co. Printers, 1881); Ignatius Donnelly, *The Great Cryptogram: Francis Bacon's Cipher in the So-Called Shakespeare Plays* (Chicago, IL: R.S. Peale, 1888); See William H. Sherman's recent work on the Shakespeare-Bacon Controversy in "Of Anagrammatology," *English Language Notes* 47, no. 2 (2009): 139–148.
53 Bacon, *Philosophy*, 524.
54 Ibid., xii.
55 Ibid., 346.
56 Ibid., 352.
57 Ibid., 371.
58 Ibid., 371.
59 Ibid., 372.
60 J. R. Hulbert, "John Matthews Manly, 1865–1940," *Modern Philology* 38, no. 1 (1940): 1–8, at 7.
61 Katherine Ellison, *A Cultural History of Early Modern English Cryptography Manuals* (London: Routledge, 2017), 8.

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Notes on Contributors

Lisa M. Barksdale-Shaw is a recent doctoral graduate from Michigan State University with a juris doctorate from the University of Michigan Law School. She considers the impact of legal spaces on literature and how they intervene within early modern culture. She has published in *The Problems of Literary Genres* (2013) and *The Facts on File Companion to Shakespeare* (2012). She serves as an adjunct professor at Saginaw Valley State University.

Karen Britland is Halls-Bascom Professor of Early Modern English Literature at the University of Wisconsin-Madison. She has edited plays by Elizabeth Cary, John Marston, and James Shirley and was associate editor for the *Cambridge Complete Works of Ben Jonson*. She has written several articles and chapters on secret writing in the 1640s and 1650s, and is preparing a monograph that expands on this material.

E.J. Christie is an Associate Professor of English at Georgia State University, specializing in Old English language and literature. He has published in *postMedieval*, *Modern Philology*, *Neophilologus*, *Literature Compass*, *Mythlore*, and *Culture, Theory and Critique*. He contributed a chapter on writing to *A Handbook of Anglo-Saxon Studies* (Wiley-Blackwell, 2012). His current research examines the role of secrecy in the relationship between epistemological theology, social organization, and the sense of self in Old English literature.

Michael C. Clody is an Associate Professor of Literature at the University of Houston-Clear Lake, where he specializes in Medieval and Early Modern Literature, Critical Theory, and the History of Poetics. His essays, including a study of the role of cryptography in Francis Bacon's natural philosophy, have appeared in *Configurations*, *ELH*, *Criticism*, and *Philological Quarterly*. He is currently completing a book on the interrelationship between the Early Modern ideals of humanism and our inherited notions of literary form.

Elsa De Luca is a music paleographer specializing in musical manuscripts from the Iberian Peninsula (tenth to fifteenth centuries). She

is currently postdoctoral fellow of CESEM – Centre for the Study of the Sociology and Aesthetics of Music at the NOVA University of Lisbon working on the development of the 'Portuguese Early Music Database' (pemdatabase.eu). She is also co-founder of 'CANTUS Index' (http://cantusindex.org/), a central catalogue of chant texts and melodies. She has studied the notation of the 'León Antiphoner' and reconstructed the manuscript's early history.

Quinn DuPont is a postdoctoral fellow at the University of Washington. He has a PhD in Information Science (Toronto), and is an ALA-accredited librarian (Western). His published articles cover topics in cryptocurrencies, cybersecurity and surveillance, feminist history, geography, computer history, retrocomputing, machine reading and writing, new media art, and e-poetry. His forthcoming book (Polity) is a scholarly survey of cryptocurrencies and blockchain technologies in society. Previously, he worked at IBM.

Katherine Ellison is a Professor of English at Illinois State University and author of *A Cultural History of Early Modern English Cryptography Manuals* (Ashgate/Routledge, 2016) and *Fatal News: Reading and Information Overload in Early Eighteenth-Century Literature* (Routledge, 2006) as well as several articles on early cryptography in *The Journal of Early Modern Cultural Studies, Book History, The Journal of the Northern Renaissance, and Eighteenth-Century Fiction.* She co-edited *Topographies of the Imagination: New Approaches to Defoe* (AMS Press, 2014) and *Digital Defoe: Studies in Defoe & His Contemporaries.*

John Haines is a Professor of Music and Medieval Studies at the University of Toronto. He has published on medieval and Renaissance music and its modern reception in a variety of journals, both musicological—from *Early Music History* to *Popular Music*—and non-musicological—from *Romania* to *Scriptorium*. His books include *Eight Centuries of Troubadours and Trouvères: The Changing Identity of Medieval Music* (Cambridge, 2004) and *Music in Films on the Middle Ages: Authenticity vs. Fantasy* (Routledge, 2013). He is a contributor most recently to *The Cambridge Companion to French Music* (2015) and *The Oxford Handbook of Victorian Medievalism (forthcoming).*

Stephen J. Harris is a Professor of Old English and Germanic philology at the University of Massachusetts and author most recently of *Bede and Aethelthryth: An Introduction to Christian Latin Poetics* (West Virginia, 2016). He regularly teaches a course on the history of cryptography.

Susan Kim is a Professor of English at Illinois State University, specializing in Old English literature. She co-authored, with Asa Simon

Mittman, *Inconceivable Beasts: The Wonders of the East in the Beowulf Manuscript* (ACMRS, 2013) and has published on the Old English *Judith*, the *Letter of Alexander to Aristotle*, *Beowulf*, and the *Wonders of the East*. Current projects include a textbook on the history of the English language (with K. Aaron Smith), a study of Alcuin's mathematical word problems, and a continuing collaboration with Asa Simon Mittman on the texts, images, and material of the Franks Casket.

Benedek Láng is a Professor, vice-dean, and head of the Philosophy and History of Science Department at the Budapest University of Technology and Economics. He has published *Unlocked Books, Manuscripts of Learned Magic in the Medieval Libraries of Central Europe* (Penn State University Press, 2008) and articles on the history of cryptography in *Cryptologia* (2010 and 2015) and *The Sixteenth Century Journal* (2014). Currently, he is working on the English edition of two of his formerly published Hungarian books: *Ciphers in Early Modern Hungary: Secrecy and the Social History of Cryptography* and *The Rohonc Code*.

Asa Simon Mittman is a Professor of Art History at California State University, Chico, where he teaches Ancient and Medieval Art. He is author of *Maps and Monsters in Medieval England* (Routledge, 2006), co-author with Susan Kim of *Inconceivable Beasts: The Wonders of the East in the Beowulf Manuscript* (ACMRS, 2013), coeditor of *Research Companion to Monsters and the Monstrous* (Ashgate/Routledge, 2012), and author and co-author of a number of articles on monstrosity and marginality in the Middle Ages in *Gesta* and *postMedieval*. He edits book series with Boydell and Brill. His current research interests include the Franks Casket and images of Jews on medieval maps.

Lisa Wilde is an Assistant Professor of English at DeSales University, where she teaches courses on rhetoric, narrative, and a variety of topics in Renaissance through nineteenth-century English literature. She has published in *Journal of the Northern Renaissance* and *Papers on Language and Literature*; her research interests include early modern rhetorics of science and mathematics, early modern drama, literature and cognition, Royalist writing, and literature of medicine.

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Index